Market Analysis for Recycled Beverage Container Materials: 2007 Update

May 10, 2007

Recycling Market Development and Expansion Grant Program

Division of Recycling
Market Research Branch

This Market Analysis report was prepared under contract by:

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Executive Summary

An important goal of the AB 2020 Beverage Container Recycling Program is encouraging development of products made from recycled beverage containers, thereby creating and maintaining a profitable beverage container recycling market for those materials recycled under the program. The State recognizes that it is not simply enough to create incentives to recycle containers, and that it is equally important to help ensure that there are viable end-uses for those containers that are recycled.

A key tool in this effort is the Division of Recycling's (DOR) Beverage Container Recycling Market Development and Expansion Grant Program (Grant Program). The Grant Program, in its second phase, now can provide up to $20 million a year in grants for recycling market development and expansion-related activities aimed at increasing the recycling of beverage containers. This is a significant recycling market development program, both in California and nationwide.

This report builds on, but does not duplicate, the analyses of recycled beverage container material markets in the DOR's 2005 *Market Analysis for Recycled Beverage Container Materials.* Much has changed since then, and many changes can be attributed to the DOR's successful Grant Program.

This current report, prepared in early 2007, provides an overview of the present status of recycled beverage container material markets; California processing/reclaiming capacity today and in 2010; market issues and barriers; competition concerns related to the Grant Program; and potential grant opportunities. The focus in writing this report has been to emphasize the implications of these various market elements for the Grant Program.

The report is based on a literature review of published and Internet sources, and interviews with 36 individuals closely involved with national and/or California recycled material markets. Representatives from most of the current or future California PET reclaiming businesses, all three HDPE reclaimers, the two glass beneficiating processors, as well as a cross-section of recyclers, processors, end-users, and industry experts were interviewed.

In recycling, as in many other markets, California is operating within the context of a dynamic global economy. Many of the market issues and barriers faced by California recyclers, processors, and end-users are influenced by factors well beyond California. Conversely, the State's market development grants are influencing recycled material markets beyond the scope of the State. Markets for recycled beverage container materials in California are influenced by the interactions between recycling rates in California and elsewhere; national and global commodity production and prices; domestic and international transportation costs; local government permitting and siting issues; the California business climate; and consumer consumption patterns. None of these multitude of factors are static, and their dynamic interactions are very complex.

Over the last few years, markets for recycled beverage container materials in California have changed significantly. These changes have occurred within the context of a generally heightened environmental awareness among government, business, and consumers. What does this mean for the AB 2020 Program, and specifically the Grant Program? Can the Grant Program leverage this increased environmental sensitivity to improve beverage container recycling in California?

The Department of Conservation has begun addressing these challenges by expanding their vision to better encompass product stewardship (already a foundation of the program), and recycling sustainability. These terms are defined as follows:

> *Product stewardship is a product-centered approach to environmental protection. It calls on those in the product lifecycle: manufacturers, retailers, users, and disposers – to share responsibility for reducing the environmental impacts of products. An example here is a retailer taking responsibility to ensure containers are collected and processed to become high quality feedstock for the manufacture of a new container.*
>
> *Recycling sustainability is an attempt to provide the best outcomes for the human and natural environments, both now and into the indefinite future. Common sustainability elements are: minimal consumption of natural resources; reuse or recycling most waste; no polluting or emitting of waste beyond what ecosystems can breakdown and harmlessly recycle; and reliance on clean, renewable energy.*

Broad concepts such as recycling sustainability are valuable; however, they sometimes lose their luster "out in the recycling yard." A challenge for the DOR is to take these higher-level conceptual goals down to implementable Grant Program actions. What that means, for each of the four major beverage container material types, is quite different. Furthermore, market conditions today, may be quite variable in the near future. Below, is a "snapshot" of the current market issues and opportunities for aluminum, glass, PET,and HDPE.

Aluminum

Aluminum sales and recycling have declined significantly over the last several years. The CRV recycling rate for aluminum was 72 percent in 2006. While this rate is much higher than the other CRV materials, it is much lower than the all-time high aluminum CRV recycling rate in 1992 of eighty-five percent. The success of the AB 2020 Program relies, in large part, on successful aluminum recycling. The key market issue for aluminum is increasing the supply of recycled aluminum.

Aluminum is in the midst of a unique market dynamic, with sustained record-high prime aluminum prices, and resulting record-high aluminum used beverage can (UBC) prices. Unfortunately, even with high scrap values, recycling rates in California have not responded. Yet, these high aluminum prices are making it slightly more difficult for processors in California to sell their material to aluminum smelters in the Southeast.

There are some technical alternatives to help increase the amount of aluminum sorted from curbside material recovery facilities (MRFs), however, these alternatives will not significantly impact aluminum collection. To truly make an aluminum impact, the DOR, recyclers, and the aluminum industry need to work together to identify creative initiatives to (1) increase the volume of aluminum recycled at buy-back centers, and (2) "mine" trash cans and landfills for the millions of aluminum cans that have been disposed.

Glass

Glass recycling has historically been a relatively stable component of the beverage recycling program, however, recycled glass markets have undergone significant changes over the last three years. The advent of single stream recycling has drastically deteriorated the quality of almost one-half of the glass recycling stream in California. This curbside glass cannot be utilized in the traditional end-use markets without extensive, and expensive, back-end processing.

While California used to be able to find in-state end-uses for almost all of the glass generated, the closure of two Southern California glass container manufacturers has resulted in a market void in the South State. Significant quantities of California recycled glass are being shipped, at great cost, to out-of-state glass manufacturers.

Another issue for California recycled glass is glass fines – those small pieces of glass left over after the screening process. Glass fines make up as much as 20 percent of all glass collected for the purpose of recycling, and for the most part they end up in landfills as no-value end-uses; such as roadbed, erosion control, lining ditches, and alternative daily cover.

There are many potential opportunities to improve recycled glass markets in California. The DOR has already provided several grants aimed at improving the quality of single stream curbside glass. While it is unfortunate that the single-minded diversion-based focus of California cities has helped lead to the deterioration of recycled materials, this dynamic is not likely to change. There will be a continued need to further invest in processing glass from single stream curbside programs, particularly as new and better technologies are developed.

A key Grant Program focus should be on finding alternatives for Southern California glass that is being shipped out-of-state. Increased use of recycled glass by Northern California glass and fiberglass manufacturers provides one potential end-use. There are also opportunities to develop new end-use markets for glass in concrete products, as well as high-end, but low-volume products such as tiles.

Identifying new ways to utilize glass fines provides an opportunity for improving recycled glass markets. There are at least two ways the glass fines issue can be addressed: (1) capturing more small glass for use by the glass container and fiberglass industries, and (2) finding new, high-value uses for glass fines. Either of these options is preferable to sending glass fines to landfills.

PET

PET is arguably the most dynamic of the recycled beverage container materials, in terms of markets. It is also the material for which the DOR's Grant Program has had the greatest impact. The landscape of PET recycling in California is rapidly evolving, triggered in large part by the combined impacts of an infusion of DOR grant monies into PET reclaiming, increased demand for recycled PET by end-users, and two years of record-high scrap prices for recycled PET.

California's recycled PET market continues to be strongly influenced by exports to China. As much as 80 percent of California recycled PET ultimately is exported to China. This leads to an inflated scrap price for recycled PET bales, and a smaller margin for PET reclaimers.

While there is currently only one PET reclaimer in full operation in California, there are several more, including those funded by the DOR, that will be operational in the next few years. When this occurs, California will not be recycling enough PET to supply these reclaimers with raw materials. This shortfall will be exacerbated by Chinese demand for California recycled PET.

An issue with serious long-term implications for both PET and HDPE recycling is the

growing use of chemical additives, differential barrier layers, and bio-resins in plastic containers. This trend is making the carefully defined legacy plastics #1 to #7 resin code system, developed after much discussion in the 1990s, less and less applicable. If this issue is not ultimately addressed, in a worst case scenario, it could collapse the plastic recycling system. In a best case scenario, it could also result in significant reductions in plastic recycling. In any event, evolving plastic "cocktail compositions" will increase recycling costs, creating challenges for recyclers, processors, and end-users.

Given Grant Program investments to date for PET reclaiming capacity in California, recycled PET markets in California may be best served by focusing on expanding end-use capability for clean recycled PET flake. Higher-value end-uses, such as food-grade PET flake and bottle-grade PET resins, could provide the greatest value added. This focus would help California PET reclaimers to compete with Chinese export markets. While California reclaimers cannot compete with China in terms of sorting and other lower-value end-uses, California reclaimers do have the ability to produce higher quality material, and to deliver that material to end-users in real time.

The Grant Program provides the DOR with a mechanism to support innovative and long-term research and development (R&D). Using grant funds to help address the technical issues of plastic resin coding, additives, bio-resins, and multi-layer containers could be an important contribution to the future of plastic recycling in California and the nation.

HDPE

Similar to aluminum, the key market issue for HDPE is lack of supply. Unlike aluminum, there are three HDPE reclaimers in California that utilize recycled HDPE. The success of these businesses depends, in large part, on the availability of California recycled HDPE. With increased demand for recycled HDPE by China, and strong domestic demand from HDPE reclaimers in the Southeast, there is simply not enough recycled HDPE available. Furthermore, the lack of supply has led to inflated prices and reduced quality for bales of recycled HDPE.

HDPE recycling is also threatened by the use of additives and multi-layered containers. For HDPE, the use of calcium carbonate as a low-cost filler in HDPE containers is increasingly problematic. The Association of Postconsumer Plastic Recyclers (APR) is working to try to educate recyclers and container manufacturers on the problems resulting from this relatively new practice. Supporting R&D on plastic resin issues, particularly on the calcium carbonate issue, will be important to the long-term success of HDPE recycling.

Opportunities to improve recycled HDPE markets should focus on increasing and improving the supply of recycled HDPE. There are also opportunities to increase the quality of HDPE collected, and to help make California HDPE reclaimers more competitive with Chinese markets by improving operating efficiency.

* * * * *

The Grant Program provides the recycling industry, researchers, and the DOR with the opportunity to improve recycling markets in California. With this opportunity there is also the challenge, and responsibility, to undertake projects that will truly make a positive difference in California recycling market development.

In 2007, scrap prices for recycled materials continue their run of all-time highs; China is a dominant force in California plastic markets; evolving beverage markets and beverage container

manufacturing practices are changing the face of container sales and recycling; and global warming has put environmental issues in the forefront of businesses and consumers. This particular set of dynamics, some positive for recycling markets and some not, may be unique to the moment. Both the DOR and grant applicants should seek to leverage existing positive market dynamics, address the negative, and "keep an eye" on long-term market needs.

* * * * *

NewPoint Group wishes to thank the many individuals in the recycling industry that were interviewed in preparing this report. We could not have prepared this report without the real-time market information that these individuals so generously provided. In the end, this report reflects our summary and analysis of interviews and the literature, and not the opinions of any one individual.

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1. Introduction

An important goal of the AB 2020 Beverage Container Recycling Program is encouraging development of products made from recycled beverage containers, thereby creating and maintaining a profitable beverage container recycling market for those materials recycled under the program. The State recognizes that it is not simply enough to create incentives to recycle containers, and that it is equally important to help ensure that there are viable end-uses for those containers that are recycled. This is accomplished through a variety of programs within the Division of Recycling, Market Research Branch.

The Beverage Container Recycling Market Development and Expansion Grant Program (Grant Program), managed by the Market Research Branch, within the Division of Recycling (DOR), was initiated in 2003. The Grant Program initially provided up to $10 million in grant funding per year, for a period of four years. AB 3056, signed into law in September 2006, increased and extended the Grant Program. The program may now provide up to $20 million annually in grants, through January 1, 2012. Grants may be awarded for recycling market development and expansion-related activities aimed at increasing the recycling of beverage containers, including, but not limited to, the following:

1. Research and development of collecting, sorting, processing, cleaning, or otherwise upgrading the market value of recycled beverage containers
2. Identification, development, and expansion of markets for recycled beverage containers
3. Research and development for products manufactured using recycled beverage containers
4. Research and development to provide high-quality materials that are substantially free of contamination (this is a new activity, added by AB 3056)
5. Payments to California manufacturers who recycle beverage containers that are marked by resin type identification code “3,” “4,” “5,” “6,” or “7,” pursuant to Section 18015” (Section 14581 (a)(11)).

During the first four years of the Grant Program, the DOR awarded 42 grants. The largest number of grants were awarded for glass-related projects. This was in large part due to the high number of glass grants awarded in the first grant cycle, when there was relatively little time for applicants to propose grant projects, and there was a strong need for off-the-shelf glass sorting equipment. The DOR has awarded a total of $9.7 million in grant funding for glass-related projects, during the first four years of grants.

The DOR has awarded five grants for plastics in general, eight for PET plastics only, and one for HDPE plastics only. Most of the general plastics grants were directed toward HDPE and PET in combination, although a few grants also addressed plastics #3 to #7. More funding has been allocated to PET plastics ($14.4 million),

than any other material. Most of these projects were directed at developing reclaiming capacity in California, either for bottle grade, flake, or sheet PET plastics. Prior to the DOR grant program, there was no PET reclaiming capacity in California. Another $7.9 million has been directed at plastics generally, primarily to facilities that process HDPE, as well as other materials. The single HDPE grant was directed at expanding HDPE reclamation capacity, and this grant was approximately $900,000.

Ten grants, and a total of $6.9 million, have been directed toward multiple materials. Most of these grants were for curbside programs, specifically for improved sorting capabilities at Material Recycling Facilities (MRFs). A relatively minimal $110,000 has been awarded specifically to aluminum, for technology to better sort aluminum from the curbside stream.

The Grant Program has had a significant impact on recycled beverage container material markets in California, and this impact should continue as existing grant projects are fully implemented and new grants are awarded. At the same time, recycled beverage container material markets in California are part of a fluid global, world-wide commodity system. Recycling activities in California impact markets beyond California, while market dynamics throughout the world impact California recycled beverage container material markets.

A. Purpose and Approach

The purpose of this report is to provide the DOR and potential grant applicants with updated information on recycled beverage container material markets. The report is also intended to assist the DOR as they review and evaluate grant applications.

This market analysis updates a previous market report prepared by NewPoint Group for the DOR. The previous report, *Market Analysis for Recycled Beverage Container Materials* (market analysis), completed in February 2005, provided a detailed and comprehensive assessment of recycled beverage container material markets, collection and processing, end-uses by material type, market issues, and recommendations. The report also included descriptions of processing and reclaiming technologies and procedures for each of the major material types, and descriptions of major end-uses categories.

This current market analysis report builds on, and updates, the first market analysis. This update report does not duplicate the background market information provided in the February 2005 report.

For detailed background information on recycled beverage container material markets, please refer to the February 2005 report. This present market analysis (1) provides a description of current market status and dynamics for each beverage container material type, (2) identifies current California market players, (3) presents current and future market capacity information, (4) discusses any new end-uses or processes, and (5) addresses market issues and barriers.

One focus of this report is to provide the DOR with knowledge that can assist them in making informed decisions for the Grant Program. Another emphasis of this report is to examine if, and how, current and potential future grants have influenced, or could potentially influence, the balance of recycled market competitive forces in California.

Thus, this report examines (1) what is currently happening in recycled beverage container markets, (2) what is expected to happen in the next few years, and (3) the implications of market events for the grant program. The emphasis of this analysis is on the major four material types: aluminum, glass, PET plastics, and HDPE plastics. While the report includes a chapter on bi-metal and plastics #3 to #7, these low-volume materials are not

Table 1-1
Per Capita Beverage Consumption, Pacific Region (Annual Gallons/Person)

Year	Soft Drinks	Beer	Bottled Water	Fruit Beverages	RTD Teas*	Sports Drinks	Wine	Spirits	Total
2001	34.2	19.3	32.8	13.4	2.1	2.3	2.9	1.2	108.2
2002	34.3	19.1	36.0	13.5	2.1	2.4	2.9	1.2	111.5
2003	34.2	19.0	36.0	13.4	2.1	2.5	2.9	1.3	111.4
2004	33.5	18.4	38.6	12.8	1.8	3.5	3.1	1.3	113.0
2005	32.9	18.2	43.0	12.0	1.7	3.8	3.2	1.4	116.2

*RTD Teas means "ready to drink" teas.

Percent Changes in Per Capita Beverage Consumption

Year	Soft Drinks	Beer	Bottled Water	Fruit Beverages	RTD Teas	Sports Drinks	Wine	Spirits	Total
2001									
2002	0.3%	-1.0%	9.8%	0.7%	0.0%	4.3%	0.0%	0.0%	3.0%
2003	-0.3%	-0.5%	0.0%	-0.7%	0.0%	4.2%	0.0%	8.3%	-0.1%
2004	-2.0%	-3.2%	7.2%	-4.5%	-14.3%	40.0%	6.9%	0.0%	1.4%
2005	-1.8%	-1.1%	11.4%	-6.3%	-5.6%	8.6%	3.2%	7.7%	2.8%
2001 to 2005	-3.8%	-5.7%	31.1%	-10.4%	-19.0%	65.2%	10.3%	16.7%	7.4%

Source: *Beverage World*, Annual Beverage Market Index (published each May)

covered with nearly as much depth as the other four material types.

B. Methodology

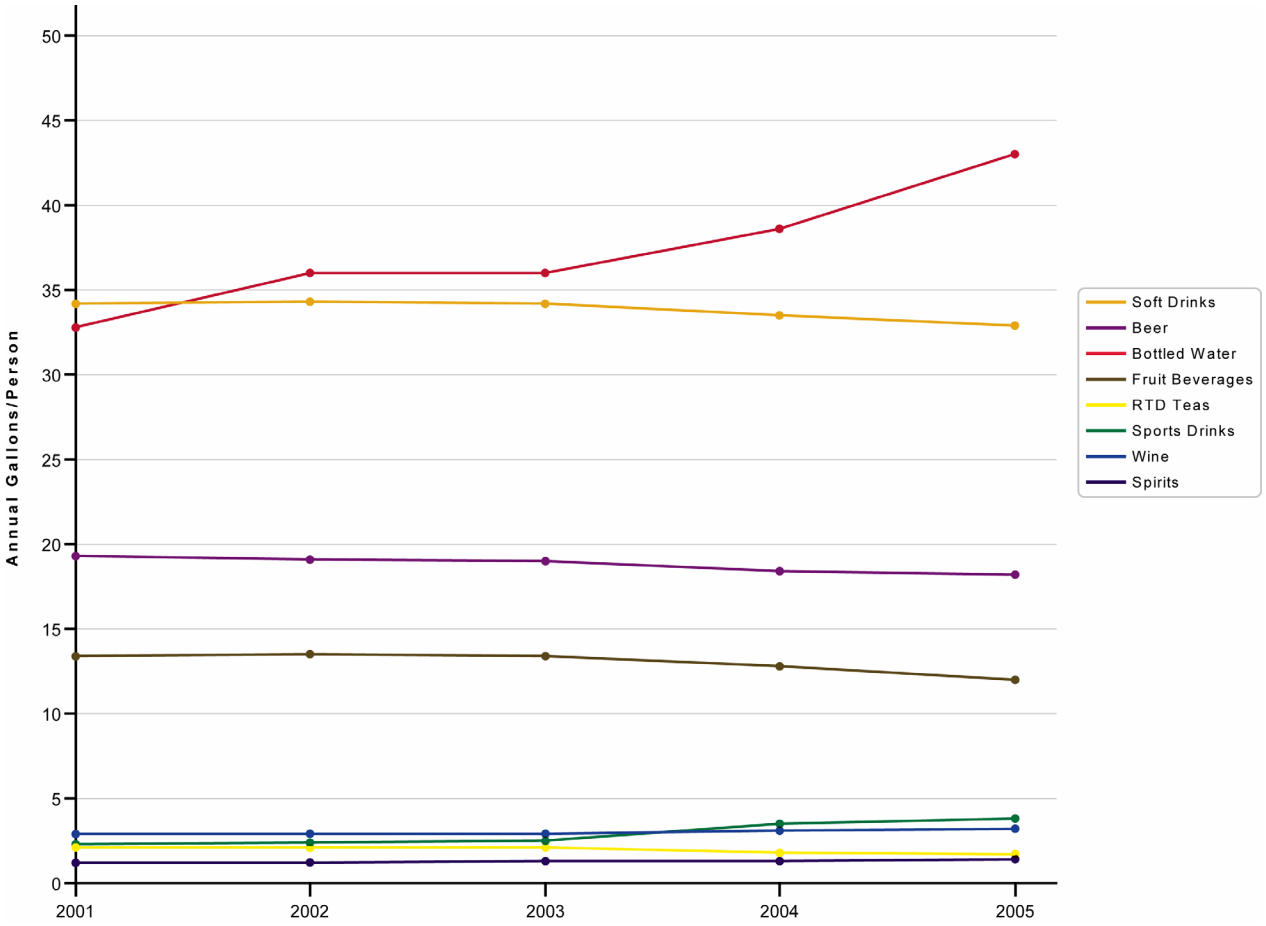
This market analysis is based on a wide range of eclectic information. We began by conducting an extensive print and Internet literature review to examine new articles published since the February 2005 report. We also reviewed Beverage Container Recycling Market Development and Expansion Grant Program awards, applications, and files, and discussed the actual progress of each grant with DOR grant managers. We obtained sales, recycling and processing volume data from the DOR to evaluate quantities of material available. Finally, we interviewed over 35 industry experts, both in California and nationally, to obtain their opinions on markets for recycled beverage container materials. References and industry experts interviewed are provided in **Appendix A**.

The report reflects a synthesis of all the information we obtained through these various sources. As might be expected when interviewing a diverse group of experts, not all agreed on market conditions, status, or expected trends. We have thus overlayed our own analysis and evaluation.

C. Beverage Container Markets

What is recycled by consumers is reflective of the beverages that consumers purchase at the store. While the focus of this report is beverage container recycling, not beverage container sales, sales activity provides insight into what is available for recycling. This section provides a brief discussion of trends in beverage container markets and sales. Many of these trends, first identified in our 2005 market analysis, have continued along the same path. **Table 1-1**, above, and **Exhibit 1-1**, on the next page, provide annual per capita beverage consumption

Exhibit 1-1
Per Capita Beverage Consumption, Pacific Region



for the Pacific Region[1], as published by *Beverage World* in their annual "Beverage Market Index" each May. **Table 1-2,** on the next page, compares total beverage gallons sold and total retail dollars for the Pacific Region in 2001 and 2005.

These tables and exhibits illustrate the changing beverage market. Soft drinks and beer, the two beverages that originally dominated the beverage container recycling program, have been slowly declining in per capita consumption over the last five years. Soft drinks have increased slightly in total gallons and dollars, while beer has decreased in total gallons, while increasing substantially in total dollars.[2] Fruit beverages, added to the AB 2020 program in 2000, have also declined by all measures, but are still consumed in greater quantities than sports drinks, teas, wine, and spirits. Sports drinks, while still having relatively low per capita consumption overall, have shown significant percentage increases in per capita and overall consumption and sales. Nationally, the "New Age" beverage category (sports drinks, energy drinks, fruit beverages, RTD teas, RTD coffees)

[1] The Pacific Region includes Alaska, Hawaii, California, Oregon, and Washington. Because about 75 percent of the region's population resides in California, these data are reflective of California consumption patterns.

[2] The increased retail dollars for beer likely reflects increased sales of higher-end craft beers.

Table 1-2
Beverage Sales in the Pacific Region*, Total Gallons Sold and Retail Dollars, 2001 and 2005

Beverage Category	2001		2005	
	Gallons Sold (in millions)	Retail Dollars (in millions)	Gallons Sold (in millions)	Retail Dollars (in millions)
Soft Drinks	1,541.40	$5,401.40	1,583.70	$6,854.80
Beer	977.10	8,125.00	875.70	12,134.50
Bottled Water	1,480.40	2,198.10	2,068.30	3,306.00
Sports Drinks	117.00	547.00	180.80	919.70
RTD Teas	95.20	520.10	87.80	478.00
Fruit Beverages	606.10	2,831.40	576.50	1,599.70
Total	4,817.20	$19,623.00	5,372.80	$25,292.70

**Pacific Region population in 2001 was 45.9 million, compared to 48 million in 2005.*

Milk sales are reported differently than the above beverages. For comparison, there were 762 million gallons of milk sold in California in 2006, just over 20 gallons per person.

has shown strong growth in all categories except fruit beverages, with the greatest increase in energy drinks (77 percent growth in volume).

The biggest driver of change in the beverage industry continues to be bottled water, which now has by far the highest per capita consumption in the Pacific Region of any beverage, even more than soft drinks. Bottled water consumption held steady between 2002 and 2003, however, bottled water growth in the region picked up again in 2004 and 2005. Nationally, the bottled water growth rate also increased from high single digits, back to double digits, between 2004 and 2005.

The strongest growth has been in PET bottled water, with total volume (gallons sold) increasing 22.3 percent between 2004 and 2005 at the national level. Even beverage industry experts such as Michael Bellas, CEO of Beverage Marketing Corporation, are surprised by the strong growth of PET bottled water, as he states, "This category is levitating up there in the 20-percent growth area and it doesn't quite seem to want to come down. I've never seen anything like it."[3] In addition to plain bottled water, the segment is growing with the addition of enhanced and fortified waters, which is expected to further erode soft drink consumption.

The dynamics of beverage container sales and recycling are shown in **Exhibit 1-2** and **Exhibit 1-3**, on the next page. Exhibit 1-2 provides percent of California CRV beverage container sales by material type since 1988, while Exhibit 1-3 provides percent of California CRV beverage container recycling by material type. In terms of recycled beverage container material markets, it is useful to consider what the beverage market changes indicate about the three major types of beverage containers consumed and recycled in California. Market implications for each material type are discussed in more detail in the remainder of this report, but in general, we observe the following:

- **Aluminum** – the foundation of aluminum beverage container sales, soft drinks and beer, is slowly eroding. At the same time, energy drinks and other

[3] Beverage World's State of the Industry Report 2006 (April 2006, p.47).

new age drinks are growing, countering some of these declines, particularly in California's more "trendy" marketplace. In 2006, California aluminum beverage container sales actually increased, rising above 10 billion containers for the first time.

- **Glass** – within the AB 2020 program, the predominant beverage type for glass containers is beer. While beer consumption per person is slowly declining, craft (micro-brew) beers, which are typically in glass bottles, are doing well. Many new age beverages and enhanced waters are also in glass, and while these are a relatively small share of the market, they may be helping to maintain glass container sales.
- **PET** – growth in PET beverage containers continues to be significant, far outpacing growth of any other beverage container material, and far outpacing population growth. With soft drink sales declining, this growth is largely driven by the PET bottled water market. Growth in sports drinks also adds to the increase in PET containers, but to a far lesser extent.

D. Report Organization

The remainder of this report is organized by recycled beverage container material type. The report provides separate sections for aluminum, glass, PET, and HDPE. Discussion of the lower volume materials, bi-metal and plastics #3 through #7, are combined into one section. The final section of the report provides a summary and recommendations. Each of the material sections is organized as follows:

A. Market Dynamics
B. Market Players and Capacity
C. New Alternatives
D. Market Issues and Barriers
E. Grant Opportunities.

This report focuses on the current status of recycled beverage container material markets, how they have changed in the last few years, and how they are likely to change in the next few years. However, recycled beverage container material markets are dynamic. What may be true as these words were written may no longer be as relevant when they are read months or years later.

Exhibit 1-2

Percent of Beverage Container Sales, by Material Type, 1988 to 2006

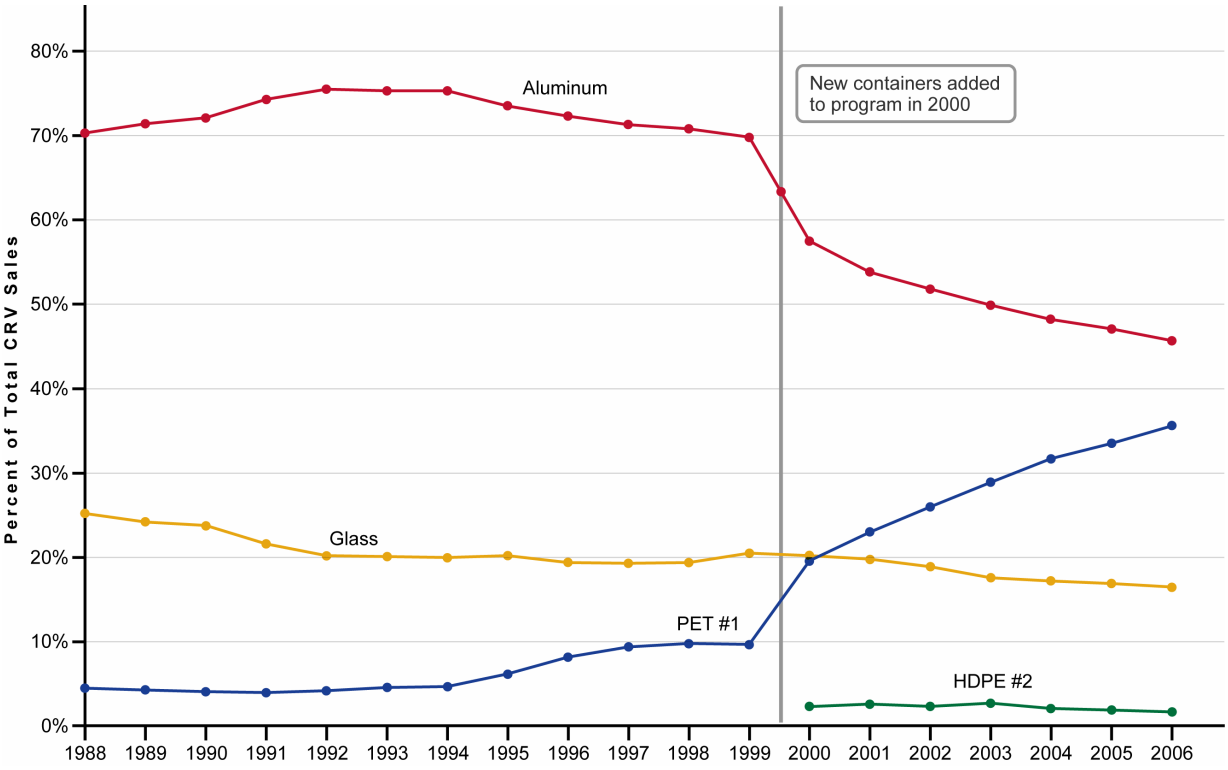
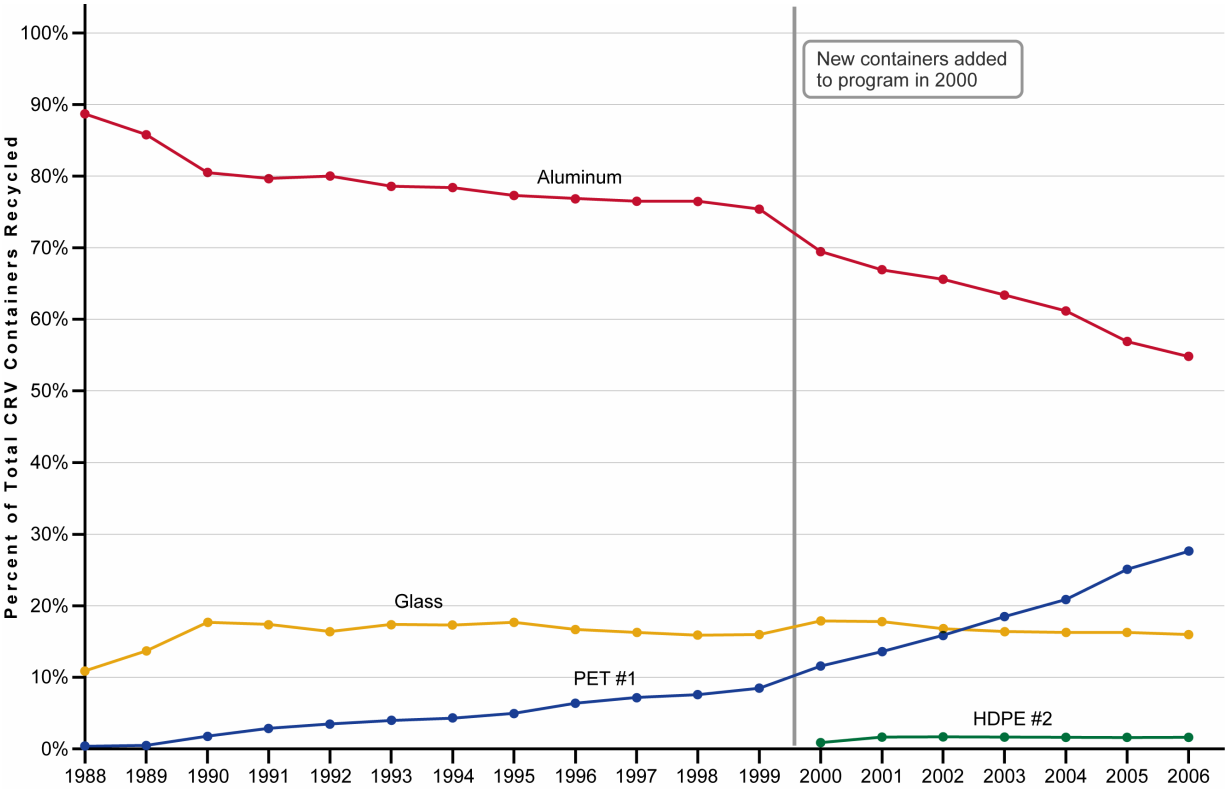


Exhibit 1-3

Percent of Beverage Containers Recycled, by Material Type, 1988 to 2006



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2. Aluminum

Aluminum has the distinction of being the most recycled material, and the most economic material to recycle, in California, and elsewhere. The following introduction, from the beginning of the aluminum section of the February 2005, *Market Analysis for Recycled Beverage Container Materials,* is still relevant today:

> Aluminum recycling is well established, with strong markets. The aluminum beverage can has been the recycling success story of the last thirty years. Within California, aluminum beverage containers have had the largest market share, and the highest recycling rate, of any material in the beverage container recycling program. Aluminum is also the only material in the program that is inherently profitable to recycle (i.e. the scrap value is greater than the cost of recycling thus avoiding the controversial processing fee and payment). Many recyclers, in fact, will pay a scrap value to aluminum customers, in addition to the CRV.
>
> In spite of aluminum's economic advantages, aluminum beverage container recycling has been struggling the last few years. There has been a market shift in the beverage container industry away from aluminum to plastic, a change that impacts the entire recycling industry. Along with the aluminum market shift, aluminum recycling has declined as part of a general reduction in recycling rates from their peak in the early 1990s.

Still, there have been, and continue to be, changes in aluminum markets since these words were written just two years ago.

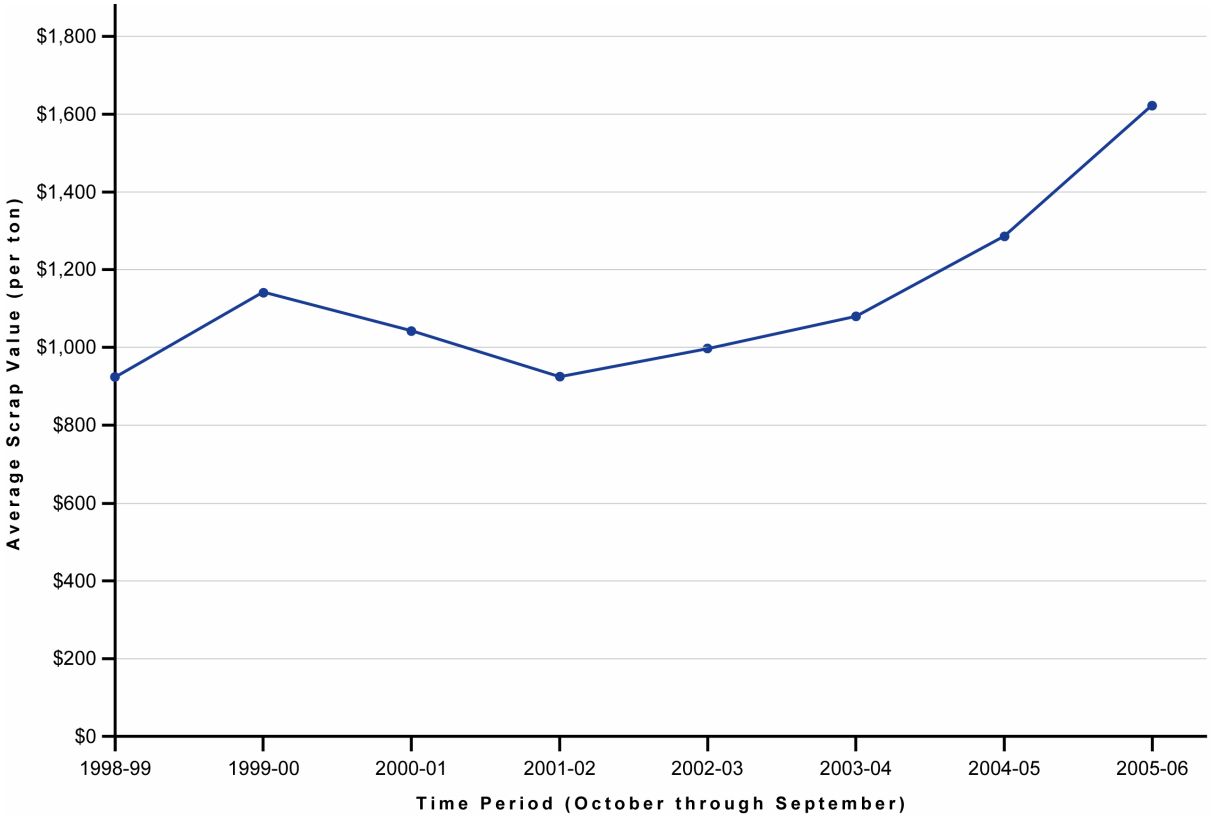
A. Market Dynamics

Perhaps the most significant change in aluminum recycling is its scrap value. Starting in early 2005, aluminum used beverage containers (UBCs) have been garnering record-high scrap values. Over much of 2003 and 2004, aluminum UBC scrap values ranged from 55 to 65 cents per pound ($1,100 to $1,300 per ton). Starting in 2005, continuing through all of 2006 and into early 2007, UBC scrap values have ranged from 80 to 90 cents per pound ($1,600 to $1,800 per ton). **Exhibit 2-1**, on the next page, illustrates average aluminum scrap values from 1998 through 2006.

Aluminum UBC scrap prices are forecast to decline slightly in 2007, as compared to 2006. However, they are still expected to be above prior historical highs, and for the first part of 2007 have remained at, or above, the high levels seen in 2006. Factors driving higher global UBC prices include a tight aluminum inventory in early 2007, and the burgeoning Asian economy (primarily China and India) driving high demand for resources and scrap materials in general, but not necessarily buying California UBC aluminum.

Buyback centers in California are passing on the high aluminum scrap price to consumers. In 2004, traditional recyclers in Los Angeles paid 10 cents per pound scrap premium to consumers for aluminum beverage cans. In early 2007, a typical Los

Exhibit 2.1
Aluminum UBC Scrap Values, 1998 to 2006



Angeles area buyback center was paying a 30 cent per pound scrap premium for aluminum, plus offering a coupon for an additional 5 cents per pound payment.

Aluminum markets are currently facing an interesting dynamic with extremely high UBC pricing, but relatively low demand, particularly for West Coast aluminum. This unusual condition is a result of several factors. Aluminum UBC prices are based on the London Metal Exchange (LME) price for prime aluminum. Over the last year, and into 2007, the price for prime aluminum has been driven two factors: (1) strong demand from China and other developing countries for aluminum; and (2) activity by hedge funds purchasing in metals markets, including aluminum. The latter reason has contributed to an artificial increase in aluminum prices, not necessarily reflective of market supply and demand.

California UBC aluminum prices are largely based on LME markets, which are dominated by world factors. However, the actual demand for California UBC aluminum is not driven by foreign demand, but almost solely by domestic demand, all of which is outside of California.

UBC aluminum prices are based on a discount factor from the LME prime aluminum price. The size of the discount factor depends on the demand and supply of UBCs, the seasonal time of year, and the exact location of the UBCs. Processors selling aluminum generated on the West Coast are currently at a disadvantage compared to processors selling aluminum generated in the East, because the secondary aluminum processors (all located in the Southeast) would prefer to buy aluminum UBCs

closer to their mills. As a result, the discount factor applied to West Coast aluminum is higher.

The high UBC aluminum scrap price is exacerbating the problem of selling West Coast aluminum UBCs. All aluminum recycled in California must be shipped out-of-state to end-use markets. Because aluminum scrap prices are so high, aluminum recycling in the rest of the country is at higher-than-typical levels, making more local aluminum available to secondary smelters. During the summer, there are even more aluminum UBCs recycled in the rest of the country.

Seasonality of aluminum beverage can production and consumption further compounds aluminum volatility. The peak season for aluminum sales and recycling is summer. To meet this summer demand for aluminum cans, aluminum sheet manufacturers are already producing, during early spring, the aluminum cans that will be sold in the summer. The UBCs that went into this aluminum sheet were purchased from recyclers and processors even earlier, perhaps during the winter. Once the summer demand peak for can production has been met, there is less demand for UBCs from secondary smelter end-markets. This drop in demand coincides with an increased supply of aluminum UBCs recycled during the hot summer months.

Reflecting these market dynamics, UBC prices have historically varied greatly by season. Typically, the winter discount factor is around 25 percent, while the summer discount factor is 30 to 35 percent. The lower summer aluminum UBC prices bring new players into the market seeking to purchase aluminum UBCs at low prices, such as the window blind manufacturer, Hunter-Douglas.

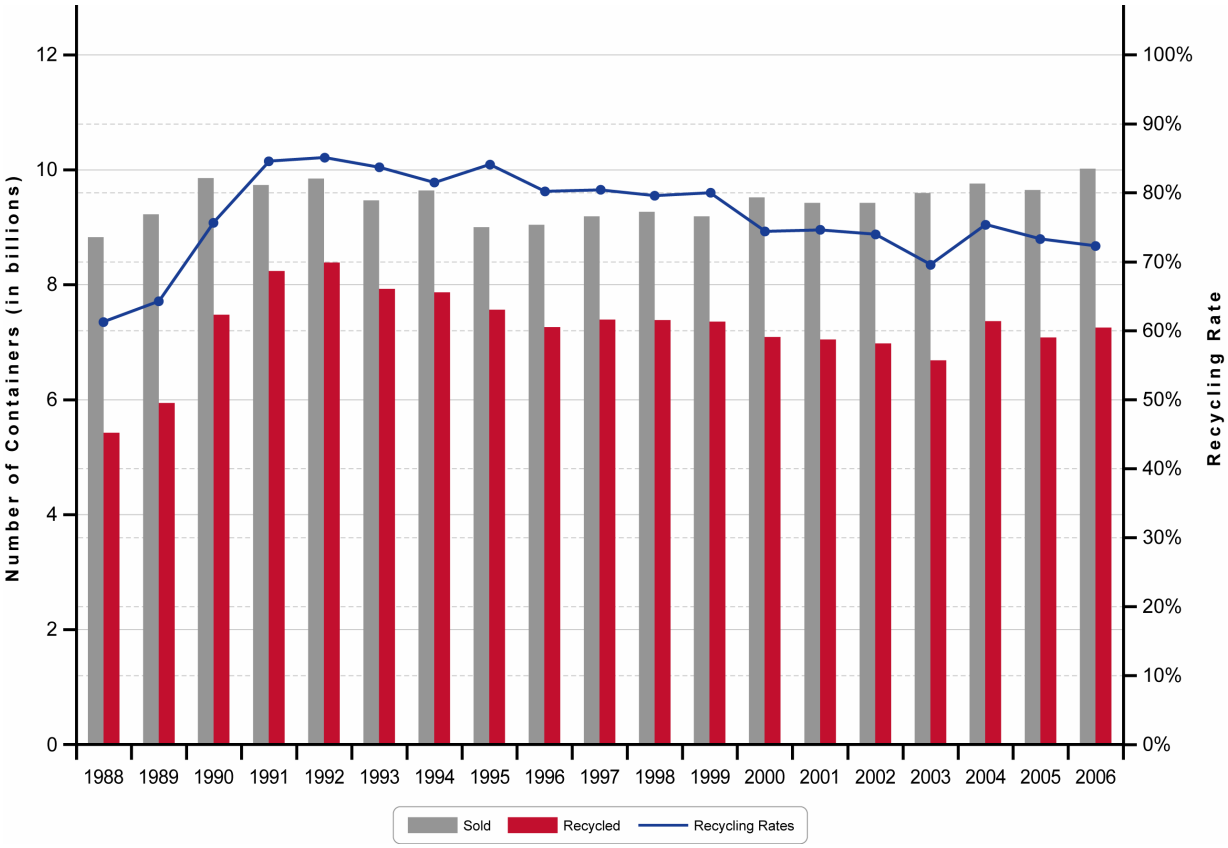
In the first months of 2007, it has been more difficult for California processors to find markets for aluminum, even early in the season. There is concern among some in the industry that by summer, smaller processors in particular will have a hard time finding buyers for aluminum UBCs. Another perspective is that processors will be able to find markets for aluminum, but it may be more challenging. Even though prices are strong, there may be low demand for aluminum beverage cans recycled in California during 2007.

Unfortunately, there is a disconnect between the high scrap prices for aluminum and aluminum recycling rates. The record high scrap values for aluminum UBCs did not drive record high recycling rates in California, or elsewhere in the United States. The most recent national aluminum recycling rates available are for 2005, with a 52 percent recycling rate, amounting to 51.4 billion cans. The recycling rate for 2005 was slightly higher than in 2004 (51.2%), however, both the total number of cans sold and recycled in 2005 declined slightly.

Aluminum recycling rates in California reached a recent high in 2004, at 75.4 percent (7.36 billion cans). This was the highest aluminum recycling rate since new containers were added to the program in 2000. The increased recycling in 2004 was likely due to the increase in CRV, from 2.5-cents to 4-cents, for a 12-ounce aluminum can, which went into place January 2004. Aluminum recycling in 2005 dropped back to just over 7 billion cans, and a 73.3 percent recycling rate.

Recycling data for 2006 show aluminum recycling rates in California increasing, although not to 2004 levels. Data from 2006 show 7.24 billion aluminum cans recycled. New incentives in AB 3056 to increase CRV payments, recycling incentives, and the quality incentive payment for curbside aluminum, are expected to boost aluminum recycling rates in 2007. **Exhibit 2-2**, on the next page, provides California aluminum beverage can sales, recycling, and recycling rates from 1988 through 2006.

Exhibit 2.2
Aluminum Beverage Containers Sold and Recycled, 1988 to 2006



Aluminum beverage containers continue to lose market share to PET, however, the aluminum industry is "fighting back" with a number of innovative new sizes and types of containers. This is "big news" in the packaging world, as in the last few years a number of new aluminum containers have been successfully introduced into the market, after years of industry reliance on only the standard 12 ounce aluminum soda or beer can. Containers that are showing increased popularity include sleek and skinny cans for energy and other new age drinks in various sizes; 12 and 16 ounce aluminum bottles with screw top lids; craft beer in aluminum cans (a market typically reserved for glass); and wine and liquor drinks in aluminum bottles. New age drinks (particularly energy drinks), wine, and craft beers are all growing beverage industry segments, with greater potential for increased aluminum can sales.

These new markets may be important to maintaining aluminum can sales, given that the two primary markets for aluminum cans, soft drinks and beer, showed declining sales in 2005. Soft drink sales in general have been slowing, primarily in response to increased health and diet concerns. The strongest sector of soft drink sales has been diet drinks, but in 2005, for the first time, even diet soft drinks showed slower or flat sales as consumers shifted even further along the health spectrum to bottled water.

Beer has been gradually losing market share in the alcoholic beverage market to wine and spirits, and in 2005, for the first time since the 1990's, showed a decline in growth. The beer declines are greatest among the major brands, or "value segment" of the beer industry, which is the segment that utilizes aluminum beer cans. Sales of beer imports and craft beer increased; however, these are typically packaged in glass bottles.

B. Market Players and Capacity

Metal recycling is a well established industry. In the United States, metal recycling accounts for more than one-half of overall metal supply by weight, and about 40 percent by value. Aluminum recycling worldwide follows a similar pattern to the overall metal industry, with figures showing that in 2003, pre- and post-consumer recycled aluminum supplied one-third of the world's new aluminum shipments.

Aluminum recycling is largely driven by economics. Using recycled aluminum requires only 5 to 8 percent of the energy required to produce primary aluminum, which results in a 95 percent reduction in greenhouse gas emissions as compared to primary production. Use of recycled aluminum also requires only about 10 percent of the capital equipment. Digging aluminum out of trash cans (or even better, sorting it out before it reaches the trash can) is considerably more economical (and has less environmental impacts) than mining and processing bauxite into aluminum.

Typically, about two-thirds of aluminum scrap is "new" scrap, from manufacturing processes (pre-consumer), and one-third is "old" scrap, essentially post-consumer scrap. About 60 percent of the old scrap is UBCs. In 2005, there were 759,000 tons of UBCs recycled nationally.

In 2006, California recycled 120,000 tons of aluminum beverage containers and post-filled aluminum, about 16 percent of the national total. The eleven states with beverage deposit systems account for the majority of aluminum recycling. These deposit states typically have aluminum recycling rates of over 70 percent, while the other 39 states have aluminum recycling rates of 35 percent or less.

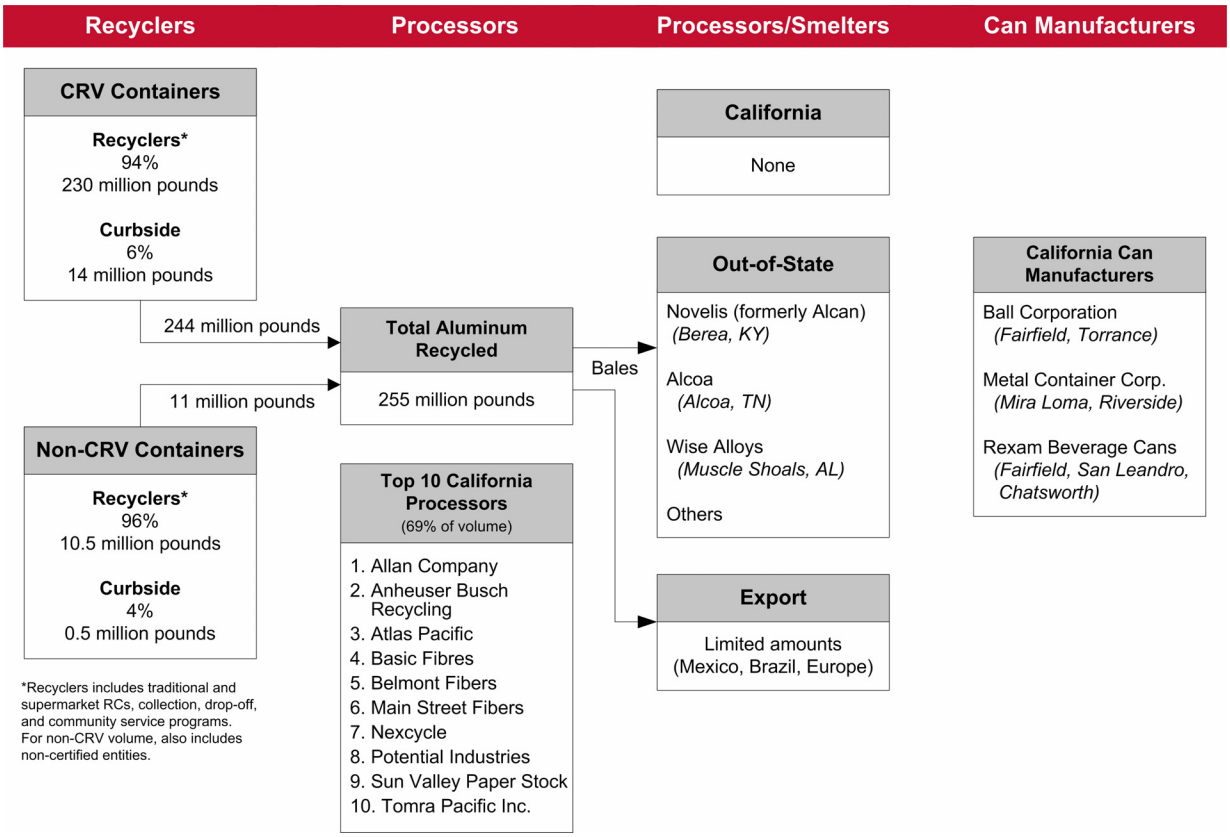
On paper, and according to the aluminum industry, there is essentially unlimited secondary aluminum smelting capacity to meet any increase in aluminum supply due to increased aluminum recycling in California, or elsewhere. Given the high price of aluminum (both primary and scrap), and high energy costs, the incentive for manufacturers to use recycled aluminum is higher than ever. That said, secondary aluminum smelters in the Southeast would likely need to make process adjustments to absorb a significant increase in aluminum beverage container recycling, and in 2007 it is getting more challenging for aluminum recyclers and processors on the West Coast to find markets for aluminum UBCs. One industry expert noted that overall, in early 2007, there was a reasonable balance between supply of recycled UBCs and demand by secondary smelters. Some in the industry expect that this may change by summer, when there could be an oversupply of aluminum UBCs.

Exhibit 2-3, on the next page, illustrates the flow of recycled aluminum generated in California, using 2006 recycling volumes. We provided a similar exhibit, using 2003 recycling volumes, in the 2005 market analysis. The quantity of aluminum containers recycled in California increased by 11 percent between 2003 and 2005, up to a total of 255 million pounds. Most of the aluminum recycled consists of CRV beverage containers, and most aluminum is recycled at recycling centers, as opposed to curbside centers.

While there have been changes within the aluminum industry over the last few years, (for example Alcan spun off their recycling arm as a separate company, Novelis, in early 2005), the basic material flow has been the same for many years. Recycled aluminum UBCs are shipped as bales from California to aluminum smelters in the Southeast. The three largest consumers of UBCs are Novelis, Alcoa, and Wise Alloys. There are other aluminum smelters, such as Aleris (formerly IMCO), however, these companies have a relatively small market share as compared to Novelis, Alcoa, and Wise Alloys.

Aluminum cans are melted and formed into can sheet, which is then shipped around the

Exhibit 2.3
Aluminum Recycling and End Uses in California, 2006



country to can manufacturing locations. These can manufacturers are typically located close to beverage manufacturers and bottling facilities, in order to minimize the cost of shipping empty cans to filling sites. Some aluminum UBCs are exported to countries such as Mexico or Brazil, however, at this point, export is a minor market for recycled aluminum.

To date, China has not shown significant interest in importing aluminum bales, as they have with plastics, although the situation could readily change. One reason that China has not become a major player in the California aluminum export market is because there is little labor required to process aluminum. As a result, there is less competitive advantage for Chinese buyers compared to those in the United States. By contrast, a bale of plastic requires labor for sorting, providing China with a distinct competitive advantage.

The California and national market capacities for recycled aluminum beverage containers are not expected to change significantly over the next three years. There are no plans to create secondary aluminum smelting capacity in California. Similarly, secondary aluminum smelting capacity in the Southeastern United States is not likely to appreciably change. If aluminum recycling rates increase significantly, the secondary aluminum industry may be able to adjust to absorb any additional aluminum UBCs that are generated. Lack of capacity may ultimately became an issue if any of the aging secondary smelters are required to upgrade and modernize their operations.

C. New Alternatives

Unlike some recycled beverage container materials, there is no need to search for new alternative markets for recycled aluminum cans. The highest, best, and most common use for recycled aluminum beverage containers is to be recycled back into new aluminum beverage containers. Industry experts estimate that over 95 percent of recycled UBCs are recycled back into new can sheet, and then formed into aluminum cans.

The post-consumer recycled content of aluminum cans is about 41 to 42 percent. Including manufacturing scrap, the overall recycled content of aluminum cans is just over 50 percent, reflecting the lower national recycling rate for UBC aluminum versus California. Occasionally, and depending on need and availability, manufacturers of other aluminum products such as aluminum siding or automobile parts purchase aluminum UBC scrap, however, these uses are a minor part of the recycled aluminum market.

The March 2007 "Former Times" segment of *Resource Recycling* noted that ten years ago aluminum recycling rates were declining. Based on changes that were occurring in the late 1990s, the story suggests several approaches that might stimulate aluminum recycling today, including: setting and measuring voluntary recycling goals; developing a nationwide recycling program; increasing promotion; increasing collection options, particularly through retailers; commissioning an aluminum industry study to develop recommendations to improve cash-for-cans recycling (versus aluminum curbside recycling); and the aluminum industry commissioning recycling experts to develop methods to capture aluminum UBCs. While some of these options are being implemented at various levels, others may merit further consideration, particularly by the aluminum industry.

D. Market Issues and Barriers

The market issue for aluminum continues to be the decline in recycling rates from the all-time high levels of the mid-1990s. The resulting market barrier is a shortage of recycled aluminum containers. In 1995, Californians recycled 8.38 billion aluminum beverage containers, for an 85.1 percent recycling rate. Eleven years later, in 2006, Californians recycled 1 billion fewer aluminum containers (7.24 billion), for a 72 percent recycling rate.

In 2006, 2.78 billion aluminum beverage cans were not recycled. Where are these valuable aluminum containers going, and how can they be captured in the recycling stream?

As we simply do not see billions of aluminum cans littering our roads, parks, or waterways, we can infer that most of these 2.78 billion aluminum cans are ending up in landfills. Over 30 percent of the CRV beverage containers that are **not** recycled are valuable aluminum cans.

In 2006, assuming a 4-cent CRV and 1-cent per container scrap premium paid at buyback centers, those "lost" containers were worth almost $139 million. Collectively, there is a significant economic incentive to recycle these containers, however even with the existing 5-cent per-container, or $4 per-Californian basis, the incentive does not appear to be enough.

There are many reasons cited for the general decline in aluminum recycling rates. Increased consumption of containers away-from-home is a commonly cited factor, although a recent beverage industry sponsored study found that the majority of containers are still consumed at home or at work. A decline in public motivation or interest in recycling, in general, and confusion about what can be recycled also are concerns. In this regard, the National Recycling Coalition (NRC) and United States Environmental Protection Agency (EPA) initiated a recycling branding campaign to help increase recycling education and interest.

Aluminum Beverage Can Recycling in Brazil

For the last five years, Brazil has achieved the highest aluminum recycling rates in the world without the benefit of a deposit system, and with very few curbside collection programs. In 2005, Brazil recycled 9.4 billion aluminum cans, for a 96.2 percent recycling rate.

The total number of aluminum beverage cans sold in Brazil is about the same as in California, however, there are few other similarities between the two entities. Still, examining how Brazil achieves these high aluminum recycling rates may provide some insight into how this can be achieved in California.

Between 150,000 and 500,000 Brazilians make their living by collecting and selling recyclable materials, primarily aluminum. Many Brazilian "scavengers" earn as much as five times more than the minimum wage collecting cans. Similar to California, containers are returned to a network of buyback recycling centers and processors, which in turn sell to the aluminum industry.

The demand for recycled aluminum is driven by the large aluminum producing industry in Brazil, which is continuously seeking to lower costs and energy consumption. Energy is a particular concern, as Brazilian industries are often required to reduce energy consumption by the Brazilian government. Much of the aluminum produced in Brazil is exported, so all UBCs that are generated within Brazil can be readily absorbed within the country. Furthermore, many export recipient countries require or request recycled content in aluminum products shipped from Brazil. As a result of these market conditions, aluminum scrap prices in Brazil are generally high.

Scavenging in Brazil has evolved into an organized entrepreneurial "industry". With the help of state and local governments, scavengers have formed cooperatives to negotiate contracts with buyers, lobby for improved work conditions (for example shelters at local dumps, uniforms, carts, and medical care), and develop guidelines for material quality. Some buyback recycling centers provide "cans for food" programs, allowing scavengers to exchange containers for food in nearby stores. Scavengers obtain recyclable materials directly from open dumps, as well as from waste bins placed at curbside. Scavenger cooperatives are responsible for more than one-half of aluminum can collections in Brazil.

In recent years, Brazil has made an effort to educate the middle class about the benefits of recycling. These initiatives have apparently been successful, as between 2000 and 2005, "condos and clubs" increased their share of aluminum recycling from 10 to 24 percent of the total. There are other government and industry recycling initiatives geared toward the middle class. For example, Tetra Pak, a global producer of beverage cartons, is sponsoring container drop-off locations at gas stations. In addition, some supermarkets and other packaging producers are working with city governments such as Sao Paulo to provide recycling collection sites around the city.

Sources:

Barlaz, Morton and Daniel Loughlin. *Strengthening Markets for Recyclables, A Worldwide Perspective: Brazil* (Raleigh, North Carolina: North Carolina State University, Department of Civil Engineering, June 2003).

"Recycling: Champion Cans" (Aluminum Association of Brazil, www.agal.org.br/english/reciclagem/latas.asp.)

Education may be an important component of boosting aluminum recycling rates. In 2003, Martha Brooks, formerly of Alcan and now COO of Novelis, stated, "Consumer behavior is critical to recyclings' success. Educating the consumer about the economic and environmental benefits of recycling is key to promoting the right behavior. We've got to make it as automatic to recycle our aluminum cans as it is to fasten our seatbelts when we get into our cars to drive."[4] Collectively, we still need to motivate that automatic recycling behavior.

Most beverage industry efforts to promote recycling are geared at increasing curbside recycling, however expanding curbside recycling is not likely to result in significant increases in aluminum recycling, because aluminum cans are primarily returned at buyback recycling centers. The aluminum industry is sponsoring the Curbside Value Partnership (CVP), with a focus on increasing education and outreach for curbside programs in order to increase aluminum participation. The CVP efforts were initially focused on non-deposit states, although the CVP is now looking beyond this initial target to other states where aluminum cans are most popular (including California).

Increased CRV payout, recycling incentives, and increased education and outreach implemented through AB 3056 may help to boost aluminum recycling rates in 2007. For aluminum, increasing the number of containers recycled is the only real market issue. Higher aluminum recycling rates are possible. California's aluminum recycling rate has been 12 percentage points higher than it is today, which is a huge differential. Brazil, although clearly not reflecting similar socioeconomic conditions, boasts a 96.2 percent recycling rate for aluminum cans (see sidebar, right).

[4] Brooks, Martha. Aluminum Can Recycling Speech, www.novelis.com (January 8, 2003).

E. Grant Opportunities and Recommendations

Only one of the 42 grants awarded during the first four years of the program was directed specifically toward aluminum (there were ten multi-material grants that address aluminum, glass, and plastics, typically at curbside programs). This may not necessarily be a reflection of the DOR's lack of interest in aluminum, but in the lack of applications for aluminum-focused grant projects. This lack of grant opportunities is in large part an indication of the market status for aluminum, with a shortage of recycled material available, as opposed to low quality material or lack of end-use markets.

The first aluminum-focused grant project, awarded to CR&R Incorporated in 2006-2007, was to add an eddy-current system at its MRF to sort out aluminum from single stream curbside materials. This may be a project that could be duplicated in other curbside MRF programs, to improve recovery of the 16-plus percent of aluminum that does go through curbsides.

Figuring out how to capture the 2.78 billion aluminum containers that are likely landfilled in California will have the largest impact on aluminum recycling rates. The DOR, recyclers, and the aluminum industry could work together to identify projects to (1) increase the volume of aluminum recycled at buy-back centers; and/or (2) "mine" landfills and MRFs for aluminum cans that have been disposed.

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3. Glass

Glass recycling has historically been a relatively stable component of the beverage recycling program, however, recycled glass markets have undergone significant changes over the last three years. First, since 2004, two glass companies operating in Southern California closed, leaving only one glass manufacturing facility in the South State, compared to four in the North. A second change relates to the ongoing trend toward single stream curbside programs. After several years of transitioning from sorted to single stream programs, the majority (by volume) of curbside recycling programs in the State are now single stream, with resulting impacts on the quality of recycled glass. Related to these two events, average glass scrap values have plummeted to very low levels.

A. Market Dynamics

The increase in single stream recycling is being addressed, to some extent, with technological solutions. With significant investments, including support from the Beverage Container Recycling Market Development and Expansion Grant Program, many California MRFs, and the two beneficiating processors, have upgraded equipment to better sort and clean single stream curbside glass. These investments in technology have helped to try to reverse the decline in glass quality that accompanied the shift to single stream recycling.

The impact of the shift to single stream recycling is evident when comparing the mix of glass purchased, by color, in 2004 and 2006. The approximate percentages, shown in **Table 3-1,** on the next page, illustrate a shift toward increased volumes of mixed cullet.

Along with this decline in quality of recycled glass has come a decline in glass scrap values. The statewide average scrap values for glass reported by the DOC may be somewhat misleading, because they represent a weighted average of both positive and negative values. Scrap values paid by processors for color sorted glass are relatively high, up to $40 per ton for flint, down to $10 or $20 per ton for clean mixed color glass. On the other hand, single stream curbside glass typically has a negative scrap value (-$10 to -$40 per ton), with lower values as contamination and the percent of glass fines[5] increases.

Exhibit 3-1, on the next page, provides historical statewide average scrap values for glass. The slight increase in 2006 glass scrap values may be reflective of the improved technological capabilities for sorting single stream glass. Recently, higher overhead for freight on the growing volume of glass shipped out of Southern California is resulting in lower scrap values for both sorted and mixed glass in the South State.

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[5] Glass fines are the name given to the small pieces of glass that sift through the processing screens. They are typically smaller than 1/4 or 3/8 inch in size, and may be mixed with similarly small pieces of dirt and other contaminants.

Exhibit 3-1
Glass Statewide Average Scrap Values, 1998 to 2006

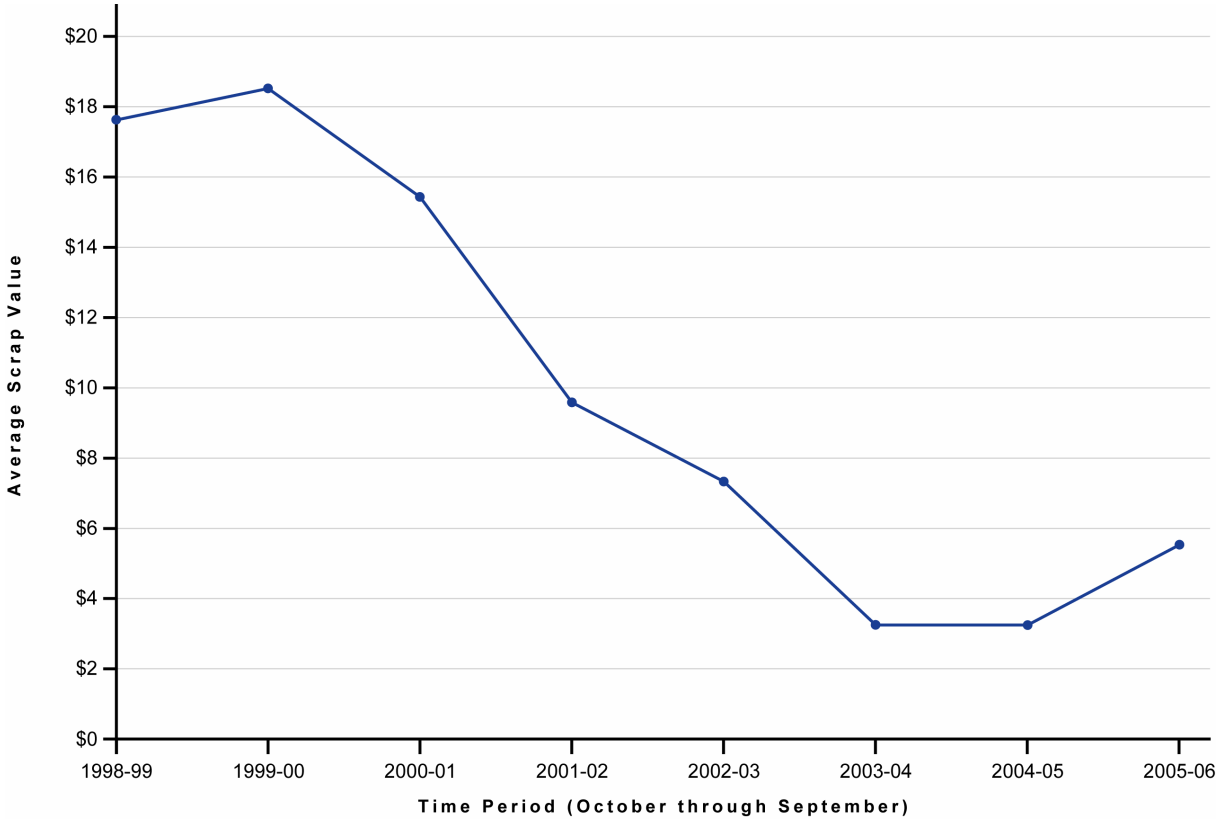


Table 3-1
Processor Glass Purchases by Color, 2004 and 2006

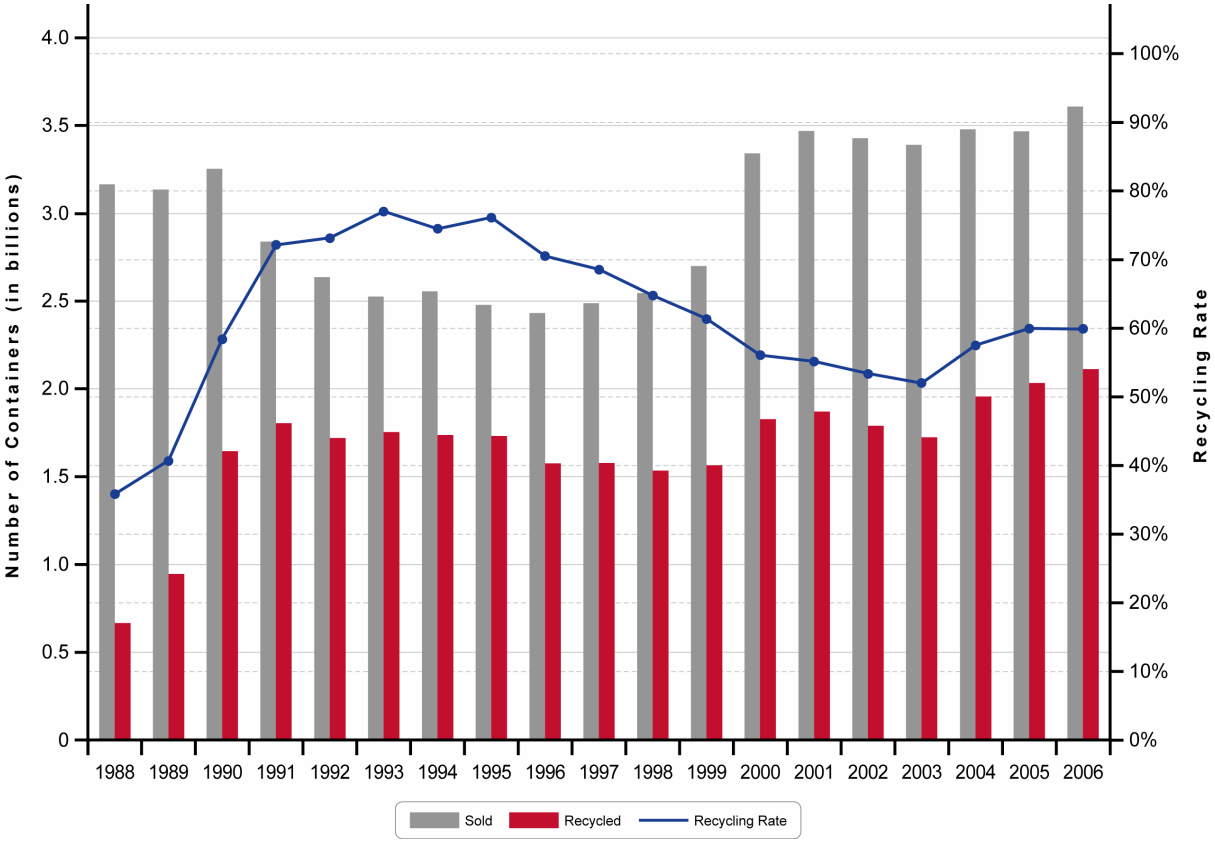
Color	2004	2006
Mixed	38%	49%
Amber	22%	17%
Green	11%	13%
Flint	29%	21%

Glass recycling appears to be slowly reversing a downward trend in glass recycling rates that started in the mid-1990s, reaching a recent record low of 51 percent in 2003. Recycling rates increased to 56 percent in 2004, and have held at 58 percent in both 2005 and 2006. In 2006, both the number of glass containers sold and the number recycled increased. The increase in glass CRV containers sold between 2005 and 2006 of 4 percent is notable, as glass container sales have not improved significantly since new containers were added to the program in 2000. **Exhibit 3-2**, on the next page, illustrates the number of glass containers sold, recycled, and the recycling rate through 2006.

Local markets are particularly important for recycled glass because the heavy weight of glass results in high transportation costs. Historically, California has had an advantage in glass markets compared to many other states because there were several glass manufacturing and fiberglass manufacturing facilities that could utilize essentially all recycled glass in California. In addition, California has recycled content laws in place for both glass containers and fiberglass. These laws require manufacturers to utilize specified percentages of recycled glass cullet.

Glass container manufacturers in California are required to utilize 35 percent recycled content

Exhibit 3-2
Glass Beverage Containers Sold and Recycled, 1988 to 2006



in their containers. If a glass container manufacturer utilizes at least 50 percent mixed color cullet, they are only required to meet a 25 percent recycled content level (i.e. Gallo Glass). Fiberglass manufacturers are required to utilize 30 percent recycled glass cullet in their product.

Northern California still has advantages over most regions of the country for recycled glass markets. However, the recent loss of two glass container manufacturers in Southern California has created a void in recycled glass markets. Today, a significant volume of California recycled glass is now being shipped from Southern California to glass manufacturers in Texas, Oklahoma, Washington, Colorado, and Mexico.

California is one of 23 states with glass manufacturing plants. Based on number of plants, the glass container industry has shrunk considerably in the last 13 years. In 1994 there were 71 glass container manufacturing plants in the United States, with 11 in California. In 2004, there were 55 plants in the United States, with 6 in California. Today there are 49 glass manufacturing plants in the United States, with 5 in California. California is also home to 4 fiberglass manufacturing facilities, all located in Northern California.

On the demand side, California's wine industry creates a strong market for glass containers. Many of these containers are not consumed within the State. California produces about 1.4 million tons of glass containers a year (CRV and non-CRV). By comparison, just over 900,000 tons of CRV containers are sold in California every year. Nationally, about 70 percent of all glass containers produced are for CRV-type beverages, and the remaining 30 percent are for food, wine, liquor, and other beverages.

Reflective of the decline in manufacturing, the glass container industry is facing an ongoing challenge from plastics for packaging both beverages and foods. No glass application appears to be immune from the threat of plastic; even plastic wine bottles are being tested in some markets.

Nationally, total glass container production declined between 2002 and 2004, but glass container shipments in both 2005 and 2006 have increased. The largest market for glass containers is beer. Shipment of glass beer containers has increased since 2002. Strong sales in the craft beer market are a positive indicator for glass containers, although that is still a small segment in the overall beer industry. Glass food containers have declined each year since 2002, which may be a factor in the proportional reduction in flint (clear) glass seen in Table 3-1.

B. Market Players and Capacity

Exhibit 3-3, on the next page, illustrates the typical flow of recycled glass within California. Approximately 75 percent of glass containers recycled in California, by weight, are CRV containers. Most of the CRV glass is returned through buyback recycling centers, however, over 40 percent of all recycled glass is collected through curbside programs. Recycled glass from buyback centers is typically clean and color-sorted. This glass requires relatively little processing before it is sold to glass container or fiberglass manufacturers, and generates a reasonably high scrap value, depending on color and location.

Processing

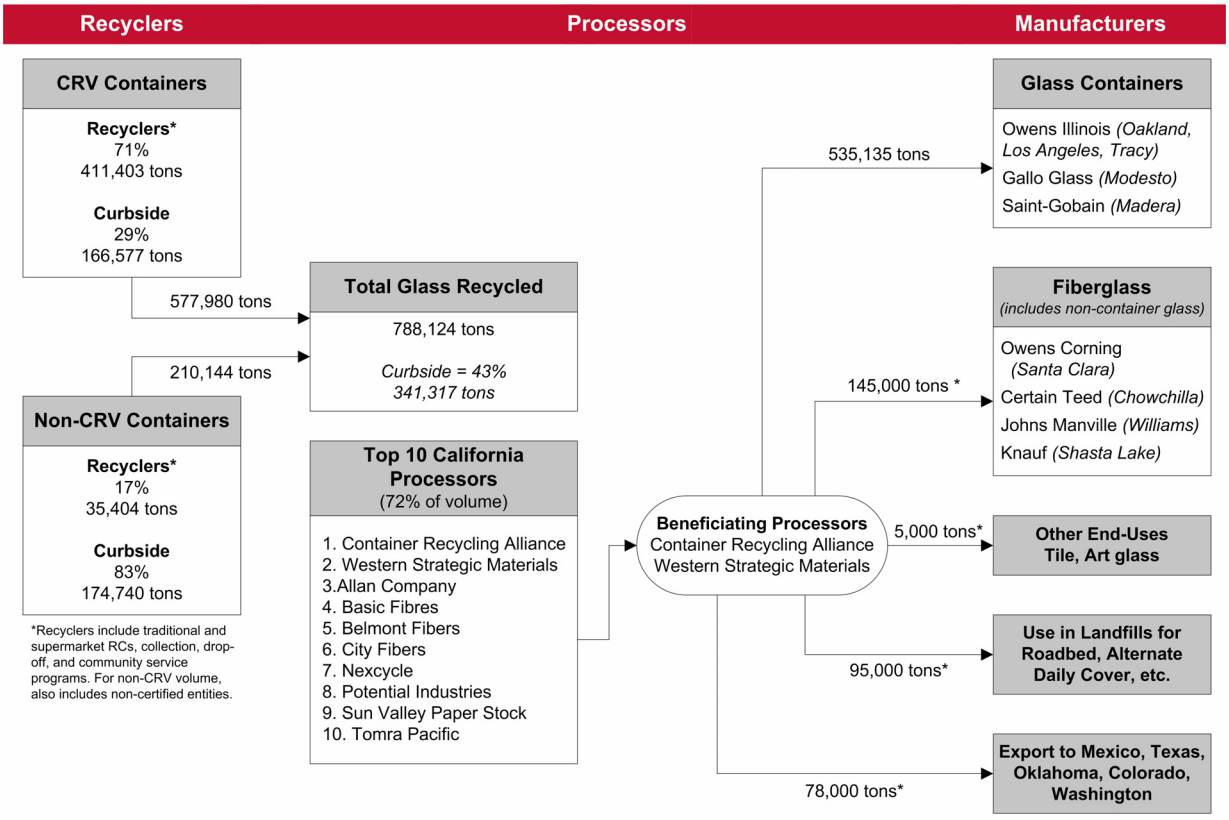
Glass recycled at curbside programs is much different than sorted glass. At most MRFs, large items, paper, aluminum, and plastic containers are removed from the sort line, leaving glass and other contaminants as a "negative sort". While some MRFs further clean and sort glass, many ship the contaminated glass mix directly to a beneficiating[2] processor (sometimes via an interim pre-processor) where it is cleaned. DOR regulations (Public Resources Code Section 2425(h)) require processors to inspect loads of commingled glass that they purchase to determine eligibility for refund value and the level of contamination in the load. The processor will reduce the weight of the load for shrinkage, as appropriate, if the load has residual or other contamination. If the load has residual or other contamination greater than 10 percent by weight, the processor must request an alternative method of preparing the shipping report (DR-6) from the DOR. The two beneficiating processors and a few other larger processors have had alternative methodologies approved by the DOR.

A relatively recent development in glass processing for single stream curbside glass is contracted pre-processing. Beneficiating processors and MRFs alike are contracting with International Recycling Industries in Brentwood to clean glass coming off of single stream curbside sort lines. This mixed glass material consists of up to 20 to 30 percent contamination, well above the 10 percent contamination limit in regulation. This pre-processor screens and cleans the glass to the point where it contains only a few percent contamination, primarily in the form of ceramics and pottery, then ships the clean glass to the beneficiating processor for beneficiation.

The recycler must pay for the cleaning on the full tonnage of material shipped, and they receive commingled CRV payment on the cleaned portion that is actually glass – typically about 75 percent of the initial volume. There is a negative scrap value for MRF line mixed glass of about -$40 per ton. The exact amount depends on the level of contamination and the amount of glass

[2] Beneficiation is the process of cleaning, sorting, and crushing glass so it is acceptable for use in glass furnaces or fiberglass manufacturing.

Exhibit 3-3
Glass Recycling and End-Uses in California, 2006



Note: End-use tonnages are estimates (with the exception of glass containers). Total glass recycled is based on received weight from recyclers prior to processing. Totals do not add to 788,124 due to use of an estimated 70,000 tons of non-container glass by fiberglass manufacturers.

*Estimated quantities.

fines in a given load of glass. Material that has a greater percentage of glass fines will receive a lower (more negative) scrap value. Recyclers still receive CRV payments for glass fines.

California capacity for beneficiating processing is limited. There are two companies operating five beneficiating facilities, Western Strategic Materials and Container Recycling Alliance (CRA). Essentially all container glass recycled in California goes through these two companies. Western Strategic Materials and CRA compete for both the raw materials (recycled glass) and end-markets for the processed glass cullet. If recycling rates increased significantly, these facilities would need to expand processing capacity in order to handle the increased volumes of glass. The economics of expanding glass processing facilities are mixed. While it is likely uneconomic to expand in order to handle additional three-mix glass, there would be significantly better economics in expanding to handle additional color-sorted buyback glass.

Increased competition and new capacity for beneficiating glass may soon be provided by eCullet. eCullet is a new player in the glass processing business. This start-up company, which has received several DOR grants, is just beginning operations at an Oakland plant using a new technology to color sort and process dirty glass. They will be utilizing glass from MRFs, and will process to furnace-ready standards for the glass container industry. eCullet hopes to reach a

capacity of 90,000 tons per year, and expects to be able to handle single stream curbside glass with as much as 40 percent contamination (although 20 percent would be preferred). As eCullet becomes fully operational, it will provide a third beneficiating processor in California.

Glass Container Manufacturers

There are three glass container companies operating in California: Owens Illinois, Saint-Gobain, and Gallo Glass. In 2006, approximately two-thirds of container glass recycled in California was sold to the glass container industry and recycled back into glass containers. In 2006, glass containers produced in California had an average recycled content of 37 percent. The Glass Packaging Institute states that glass container manufacturers can utilize up to 70 percent recycled content. **Exhibit 3-4**, on the next page, illustrates glass containers produced, cullet utilized, and average recycled content from 1994 to 2006.

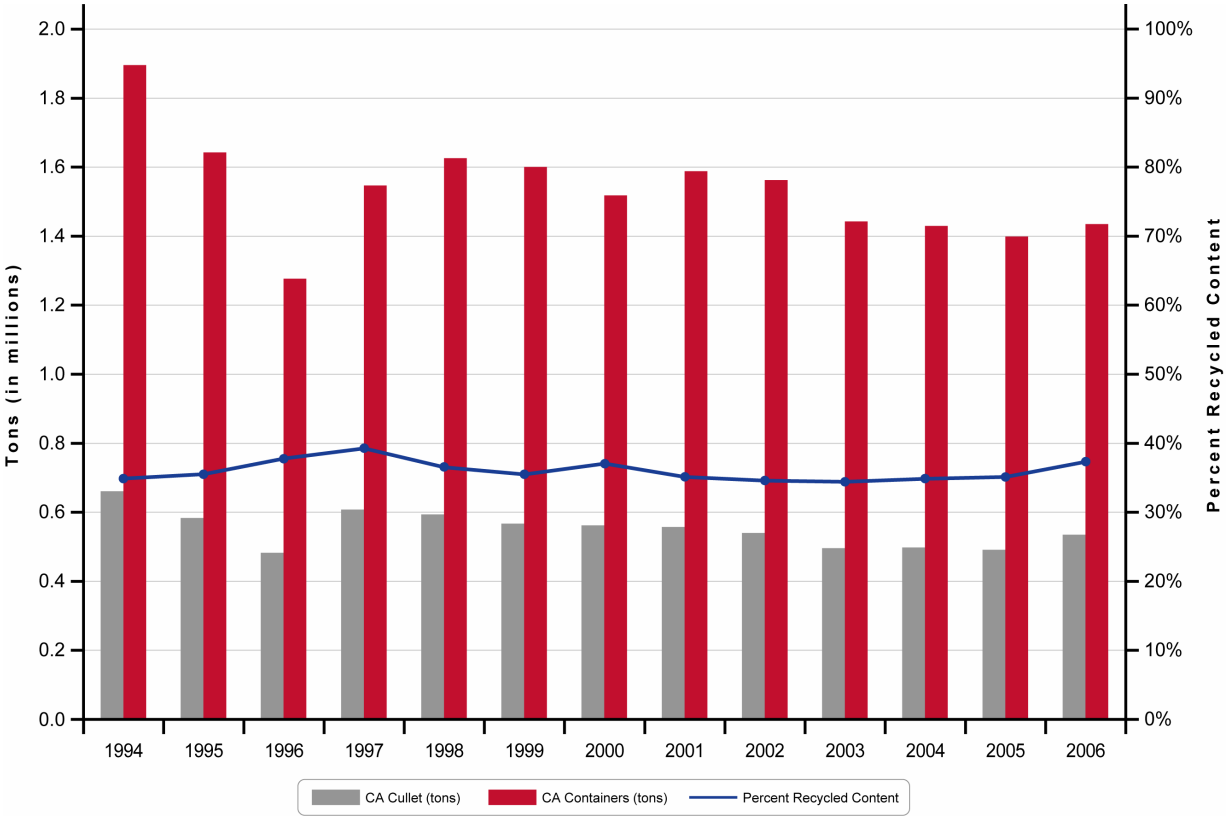
Obtaining high quality, color-sorted cullet is always a concern among glass manufacturers, and the lack of more high quality cullet is cited by container manufacturers as the reason they don't use greater quantities of cullet. There are distinct advantages to using glass cullet in container manufacturing as compared to the traditional raw ingredients (sand, soda ash, and lime): (1) the furnaces can be run at a lower temperature, reducing energy costs; (2) cullet can be run through the manufacturing process faster; and (3) there is less wear on the furnace, extending the time the furnace can operate before it must be rebuilt (requiring a 40-day shutdown). Generally, these advantages outweigh potential problems with using cullet, such as increased variability in feedstock, color consistency, and higher loss. Ceramics are the major contaminant of concern for glass manufacturers.

A Saint-Gobain glass container plant closed in Southern California in 2004, and another Saint-Gobain recently closed their El Monte glass container facility, losing both an amber and flint line in the South State. As a result, there are now four glass container manufacturing facilities in Northern California, and only one in Southern California. The closing of these facilities has reportedly resulted in about a 100,000 ton per year production decrease. Although this decline did not show up in the 2006 production figures, demand for recycled glass in Southern California is down in 2007.

Glass manufacturing facilities in California are closing for two general reasons. The first reason is the ongoing decline in glass market share for food and beverages. Plastic has entirely changed the composition of the food and drink container market, replacing both glass and aluminum. In addition to declining market shares, many glass manufacturing facilities use old technologies that no longer meet existing environmental standards.

Reportedly, glass manufacturing facilities in Southern California could not comply with current Air Quality Management District (AQMD) standards without making major facility upgrades. For a glass manufacturer, such as the recently closed Saint Gobain facility which made lower-value clear glass, it is more economical to make glass containers out-of-state (with lower environmental standards) and ship containers back into California to be filled, than to make the required plant upgrades. By comparison, higher-value glass container manufacturing facilities (such as those producing wine bottles) can, and have, more easily afforded furnace upgrades necessary to comply with California's air quality standards.

Exhibit 3-4
California Glass Container Production and Recycled Content, 1994 to 2006



Fiberglass Manufacturers

Fiberglass manufacturers state that they would utilize more recycled glass if more glass meeting their quality standards were available. Organics contamination is a significant concern for fiberglass manufacturers, with tolerance rates well below 1 percent. Fiberglass manufacturers can utilize mixed color cullet, as long as they can be sure that the quality meets their specifications.

The fiberglass industry consumes about 140,000 tons of recycled glass each year, although this figure includes a potentially large volume (as much as 70,000 tons) plate and other glass, in addition to containers. All four fiberglass manufacturers are in Northern California. Fiberglass production in California has increased over the last several years; however, the decline in the housing market may potentially lead to a reduction in the demand for fiberglass insulation.

Other High Value End-Uses

A small amount of glass, perhaps 5,000 tons at most, are utilized by small art glass and tile businesses. These entities can utilize some glass fines, and there is potential for growth in this area, although overall volumes are still likely to be low. An advantage of these glass market alternatives is that they have a high value added. For example, countertops retail for about $50 per square foot, and a large recycled glass bowl could sell for at least $50. Robert Kirby of Dogged Enterprises estimates that it takes 500 tons of glass in the container manufacturing industry to support one job, while it takes only 62.5 tons of glass in the tile manufacturing industry to support one job.

Within California, Fireclay Tile Inc., based in San Jose, has developed a line of tiles, the "Debris

Series" that utilizes 50 percent recycled materials, including glass (with fines) and granite dust. Fireclay Tile is also working with Robert Kirby to develop an 80 percent recycled glass countertop. This new application could utilize about 25 tons per year. Fire & Light, located in Arcata, creates glassware using about 140 tons per year of clear glass collected from the Arcata Community Recycling Center. Oceanside Glasstile, located in Southern California, uses about 1,000 tons of curbside glass per year in their glass tiles.

No-Value End-Uses

There is a significant amount of recycled glass that ends up in landfills, perhaps as much as 100,000 tons per year of glass fines and reject glass. Currently, beneficiating processors cannot readily handle material less than 1/4 inch in size. The vast majority of these glass fines, as well as reject glass, are sent to landfills. Technically this material is not disposed, as landfill operators typically use the glass within the landfill as road base, erosion control, in drainage ditches, and potentially as alternative daily cover. Much of this material, in the form of glass fines, still receives CRV payments.

Export from California

Given the weight of glass and resulting high transportation costs, the location where glass is generated is important for end-use markets. With only one glass manufacturer, and no fiberglass manufacturers, in Southern California, there is an oversupply of glass in the South State. Historically, some glass cullet has been shipped from San Diego to glass manufacturers in Mexico, due to proximity. However, starting in 2006, volumes of glass shipped out of California increased. While some Southern California glass is shipped to Northern California, much of it is shipped to glass manufacturers in Mexico, Texas, Colorado, Washington, and Oklahoma. In 2006, estimated glass exports were approximately 75,000 tons. In early 2007, shipments of glass cullet out-of-state were approximately 9,000 tons per month. If this rate continues throughout the year, exports from California in 2007 will reach almost 110,000 tons.

Exhibit 3-5, on on the next page, compares California recycled container glass end-uses in 2006 with potential "best" case scenario recycled container glass end-uses in 2010. This future scenario assumes that California will develop and/or expand alternative markets in two key areas: (1) tile, brick, and art glass, and (2) concrete, stucco, and blasting medium alternatives. In addition, the 2010 scenario assumes that processors will implement technologies to utilize glass fines that are between 1/8 and 1/4 inch in size. Expansion in these three areas will reduce the amount of glass going to no-value uses in landfills, and the amount of glass being exported to out-of-state container manufacturers. While this is a best case scenario because it is economically optimistic, it is potentially feasible.

C. New Alternatives

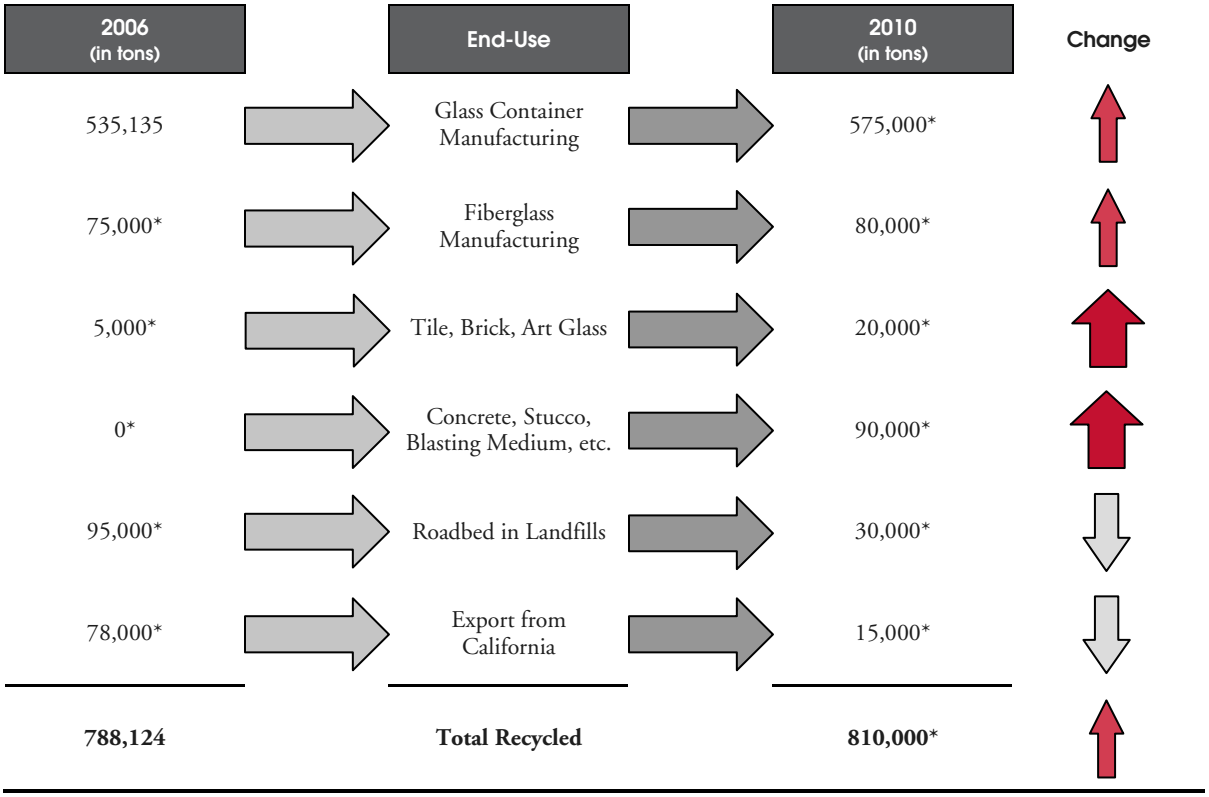
There is no shortage of alternatives that utilize recycled glass. In the early 1990s, the Clean Washington Center identified almost 100 technically feasible alternatives for recycled glass. The problem is that while there are many things one can do with recycled glass, most are not economically feasible.

In the 2005 Market Analysis, we noted three general categories of glass end use:

1. High-value and high-volume end-uses that require extensive processing, such as glass containers and fiberglass
2. Low-value and high-volume end-uses that require less processing, and also provide less, or no, scrap value, such as aggregate and drainage filler

Exhibit 3-5

Comparison of 2006 California Glass End-Use to Potential "Best" Case 2010 California Glass End-Use



**Estimated quantities*

3. High-value and low-volume specialty end-uses such as tile, art glass, blasting medium, and brick.

The first category provides the most established and largest end-markets for recycled glass. As noted above, most of California's recycled glass is used by either the glass container or fiberglass industries. The low-value and high-volume markets in California are not well developed, and it appears that much of the low-quality glass ends up in the landfill, either as roadbed, in drainage ditches, or for erosion control. New low-value, high-volume applications are always being considered, such as the use of glass for beach erosion control in Florida. Due to the declining quality of recycled glass, almost every end-use requires extensive processing. Any low-value alternative that requires processing or cleaning of the glass becomes immediately uneconomical due to the high cost of cleaning three-mix curbside glass.

There continue to be a number of potential options in the high-value, low-volume category, such as glass art, tile, bricks, and countertops. Recycled glass can be utilized in all ceramics processes, and has benefits such as speeding drying and firing; decreasing the need for water; lowering the temperature for firing; and saving energy.

There is growing interest in a potentially high-volume, category of glass alternative, using glass as a substitute for sand in concrete applications. Although there are significant barriers, these applications have the potential to provide needed markets for large quantities of glass. Using glass in cement applications requires specific formulations and chemicals in order to avoid Alkali Silica

Reaction (ASR), which leads to cracking and instability. A significant hurdle is that the glass must be clean, with no sugars or other organic contaminants. For stucco applications, the glass should be rounded, which requires additional processing. Recycled glass in concrete has advantages over sand, eliminating concerns of silicosis, reducing the need to mine sand, and providing improved manufacturing productivity.

Reportedly, a stucco manufacturer in Southern California is interested in utilizing recycled glass. In addition, a California start-up company, is looking to utilize up to 100,000 tons of recycled three-mix glass per year in many different building applications, including mortars, stucco, and large-volume manufacturing. Recycled glass can be utilized in highway sound barriers, Jersey barriers, and concrete pavers. The concrete block industry could also utilize significant volumes of recycled glass, creating local markets for the material. These concrete applications, while previously uneconomic as compared to glass container manufacturing, may now warrant consideration given the lack of glass markets within Southern California.

Another category of new alternatives for glass involve process changes and procedures to improve quality. For example, the *Single Stream Recycling Best Practices Manual*, developed by Susan Kinsella and Richard Gertman under a market development grant, identifies six basic procedural changes that can improve material processing of glass. Most of these recommendations require more careful handling, not technological solutions, for example: dump the glass load from the collection truck onto a softer surface; avoid pushing glass into large piles with bucket loaders; remove glass at the beginning of the processing system when bottles are still whole; separate breakable contaminants such as ceramics before crushing the glass; avoid using hard spinning discs and devices until glass has been removed; and once the glass has been separated from other materials, sort it by color.

D. Market Issues and Barriers

Below, we identify and discuss four key inter-related market issues and/or barriers:

1. Lack of recycled glass markets in Southern California
2. Increasing quantities of contaminated glass from single stream curbside
3. Large quantities of unused glass fines,
4. A relatively closed system for glass processing.

1. Lack of Recycled Glass Markets in Southern California

Currently, as much as 9,000 tons per month of recycled glass are being shipped from Southern California to glass container manufacturers in Texas, Oklahoma, Colorado, Washington, and Mexico. Exporting this significant quantity of glass is not economically or environmentally sustainable. Even without incurring additional freight charges, there is very little margin in recycling glass. The additional freight charges create a burden at all levels of the glass recycling process: from recyclers, to processors, to beneficiating processors, and to glass container manufacturers. Environmentally, it is unlikely that the energy efficiency gains from using recycled glass in new containers outweigh the fuel consumed moving glass from California to Texas. This loss of glass manufacturing capability in California increases the interest in, and need for, alternative markets for glass cullet in Southern California.

2. Increasing Quantities of Contaminated Glass from Single Stream Curbside

The shift to single stream curbside has resulted in drastic declines in the quality of glass coming into MRFs and processing facilities. While buyback, and even dual stream glass (from curbsides that separate paper from containers) have relatively pure glass streams, it is not

uncommon for single stream curbside to contain as much as 40 percent trash, glass fines, and other contamination, with contamination of between 20 to 30 percent the norm. This contamination is a significant issue for glass. Curbside glass makes up almost one-half of the total amount of glass collected, and a majority of curbside glass is now from single stream collection programs.

Single stream curbside programs impact glass quality more than other materials because glass is typically a negative sort item. This means that large items, paper, plastic, and aluminum are removed from the process line, leaving glass along with whatever else is left. Because glass breaks, the resulting material is a mix of varying sizes of glass pieces, labels, wrappers, dirt, caps, and organic materials. For example, a typical 25 ton load of glass from a MRF might contain 15 tons of useable glass, 4 tons of glass fines and rejects, and 6 tons of garbage.

The quality of single stream glass varies significantly between communities. As would be expected, those programs with additional sorting equipment have higher quality glass. However, the level of education and enforcement in a community, as well as the garbage rate structure, also are important.

In some communities it is difficult to look in a container at the curbside and tell the difference between trash and recycling. Trash that doesn't fit in the trash receptacle is simply placed in the recycling bin. As long as the material is still picked up, there is no incentive for citizens to change their behavior. Increased contamination of recycling is also an unintended consequence of pay-as-you-throw rate setting for garbage collection. These programs are effective in reducing the amount of trash generated, however, without education and enforcement, some participants choose the smaller and cheaper trash can, and use the recycling bin for overflow. The result is a highly contaminated recycling stream.

Several of the early grant projects were focused on sorting glass at MRFs. A number of grants were awarded to purchase sorting technologies such as the "Titus Glass Fines Recovery System" and "General Kinematics De-Stoner." These systems can significantly reduce the contamination in glass loads from a MRF – with contamination decreasing at some facilities from 30 to 40 percent, down to about 7 percent.

In implementing their grant projects, glass processors found that cleaning glass was an important issue. Even the most technologically advanced optical sorting systems are not effective if the feedstock is highly contaminated. Thus, it is important to "pre-process" the material so that it can be further sorted. There is a significant economic cost in cleaning glass. In general, the negative scrap value of single stream curbside glass – typically -$40 per ton, balances the approximately $40 per ton cost of cleaning, with a net value of $0. The need to spend significant resources cleaning glass limits the potential downstream uses. Because glass replaces sand in many applications, there is no interest in paying more for recycled glass than the cost of sand, which is just under $60 per ton.

3. Large Quantities of Unused Glass Fines

A key issue with glass in California is glass fines – those small pieces of glass left over after the screening process. Typically, beneficiating processors utilize screens to help sort and clean the material. These screens catch the small pieces of glass, either 1/4 or 3/8 inch in size and smaller. This material is too small to be captured, and is left as a negative sort. The total volume of glass fines is significant, perhaps 20 percent of recycled glass. In addition to glass fines, glass rejects occur during processing. When the automated sorting systems detect and remove ceramics and other contaminants, adjacent pieces of glass often get removed also. Thus, a small amount of glass

rejects are an inevitable part of processing. In 2006, close to 100,000 tons of California recycled glass fines and rejects ended up in landfills in no-value uses – roadbed, erosion control, lining ditches, and alternative daily cover.

4. A Relatively Closed System for Glass Processing

There are only two beneficiating processors operating in California, and essentially all glass recycled in the State passes through either one of these two companies. This dynamic creates two separate supply/demand relationships for recycled glass: one between the recycler and the beneficiating processor, and one between the beneficiating processor and the end-user. Prices in the first case are determined by the beneficiating processor, and prices in the second case are generally determined by the price of raw materials for the glass container and fiberglass manufacturing industries, typically $50 to $65 per ton.

While this system works reasonably well for moving recycled glass to the glass container and fiberglass manufacturing industries, there are limitations. This dynamic creates a bottleneck in glass recycling markets. It is difficult for new players to enter glass recycling, either at the processing or end-use stages. eCullet's start-up operation could provide an additional alternative for both recyclers and end-users.

This closed system is also not well-suited for smaller-volume processors or end-users. Recyclers sell all of their glass to the beneficiating processors, and beneficiating processors sell essentially all of their usable glass to glass container or fiberglass manufacturers. A high-value, low-volume end-user has little market power when it comes to purchasing recycled glass.

The use of recycled glass in aggregate illustrates several of the market issues identified above. Aggregate has never been a major end-use for recycled glass in California, and it is becoming even less so. In 2003, we estimated that about 20,000 tons per year of recycled glass went to aggregate. Today, that figure is minimal, as the recycled glass market for aggregate has declined along with the quality of curbside glass. There is little to no interest within the California aggregate industry to utilize recycled glass.

The quality requirements for aggregate are quite high. Caltrans requires a very low percentage of organic contamination. If organic content of the glass is high, the road bed will settle as the organics decompose, a situation that is not acceptable in road construction. At the same time, the aggregate industry is not willing to pay for recycled glass material, and may require payment to take the recycled glass. Given the declining quality of the curbside recycling stream, it is simply not economical to clean the glass to a level that meets the aggregate industry requirements. For slightly more cleaning and cost, the glass can be processed to meet the fiberglass industry's slightly lower organic contamination requirements, and generate a significantly better price.

E. Grant Opportunities and Recommendation

There are many potential opportunities for grant projects that address recycled glass markets. Grant projects ideally should focus on reducing the amount of recycled glass exported out of California and/or reducing the amount of glass going to no-value uses in landfills. There are also grant opportunities that address the four market barriers identified above. Below, we identify six areas that could be addressed by specific grant projects.

1. Capture Glass Fines

While currently considered unusable, or at least uncapturable for glass containers and fiberglass, fines contain a high percentage (about

95 percent) glass. The volume of fines in California is significant. Fines make up a major portion of the reject/fines glass that cannot be used by container and fiberglass manufacturers.

There are several possible approaches to the fines issue. One alternative is to develop or utilize technologies that will sort and clean these smaller glass fines so that they can be utilized by the fiberglass and glass container industries. Currently, glass that is smaller than 1/4 or 3/8 inch is removed during processing because technologies in use at processors today cannot detect and remove ceramics that are smaller. If smaller size ceramic contaminants could be removed, then smaller sized glass could be utilized.

There are technologies on the market that reportedly can remove ceramics as small as 1/8 inch in size. Using such systems could allow more glass to be utilized in containers and fiberglass. This approach would reduce the screen size to the minimum possible, perhaps 1/8 inch, and thus reduce the volume of fines. This alternative might cut the volume of fines by as much as 60 percent.

2. Utilize Glass Fines

Another approach to addressing the issue of glass fines is to identify ways to utilize the fines. Both ceramic and concrete applications can utilize some percentage of glass fines. Many of these ceramic processes takes advantage of the chemical characteristics of glass as a binding agent, as compared to some other alternatives that utilize glass for its aesthetic qualities. This type of alternative is attractive because it creates a high-value end-use product out of essentially reject material, however, at least at this point, it will only utilize a minute share of the total amount of cullet and fines generated. Using recycled glass in Portland cement applications may provide opportunities to use greater quantities of glass fines. Efforts to develop ways to productively utilize glass fines should be encouraged.

3. Increase Recycled Glass in Tile and Brick

Recycled glass can be effectively and attractively used in tile and brick products, providing efficiency gains and reducing energy use. These high-value end-use markets are relatively undeveloped, and have potential to use several times more glass than the current level of about 5,000 tons per year. Tile and brick manufacturers can provide local markets, reducing the need to transport glass long distances. Development of small-scale glass processing operations (see #6 below) would advance the use of recycled glass locally in these smaller-volume operations. The DOR funded a grant project to the Center for Environmental Economic Development to promote use of recycled glass in brick.

4. Develop Applications for Recycled Glass in Concrete Products

There is a need to fill the market void left by the loss of recycled glass container manufacturers in Southern California. This can best be met by new large-scale market alternatives to utilize the 9,000 tons per month of glass that are currently being shipped out-of-state. The use of recycled glass in concrete building applications, including stucco, has the potential to utilize significant quantities of recycled glass, eliminating the need to transport material out-of-state. These applications may require different processing techniques than are used for glass container and fiberglass manufacturers.

5. Improve Recycled Glass Quality

Another potential category for grant projects is glass cleaning. There is widespread agreement on the need for, and importance of, more efficient and effective cleaning for single stream curbside

glass. With almost one-half of all glass being generated in a highly contaminated form, it is imperative that this material be cleaned. Both the glass container and fiberglass industries say they would like to use more glass cullet, with the huge caveat, if quality cullet is available.

Optical sorting equipment can sort by color and remove ceramics, however, it is not made to handle organic contamination and trash. The glass that is presented to the optical sorter must be clean. Both investments in existing technologies such as fluidized bed dryers, and research and development for new cleaning technologies would be beneficial.

An alternative approach to better quality glass, currently being examined in a DOR grant project by Environmental Planning Consultants, is to develop lower impact processing methods. This option would reduce the amount of glass breakage, thus allowing for more glass to be sorted and cleaned before it becomes too small to be utilized. Given the highly contaminated status of single stream glass, there is room for improving quality at both the front-end and back-end of glass processing.

6. Develop Small-Scale Glass Processing

The glass processing infrastructure in California is, understandably, directed at moving large quantities of recycled glass into the glass container and fiberglass industries. The system is generally working well for that purpose, particularly given the new technology investments to clean single stream glass.

The large-scale glass processing system does not work as well for the niche alternatives such as tile and glass art. These are high-value markets, but manufacturers have difficulty finding and sourcing glass because they are so small. These end uses create markets for less than one percent of the recycled glass generated in California, however, they can create a significant number of jobs, value-added, energy savings, and promotion of recycled content products. Interestingly, one of the best sources of recycled glass, and one that is utilized by niche end-users across the country, is based in Utah. There is a need for small-scale glass processing equipment to crush low volumes of glass, which could then be sold to niche end-users.

4. PET

Of the ten beverage container material types, California markets for recycled PET have changed the most over the last several years. These changes are the result of a unique series of events, including: record high gasoline prices leading to high virgin and recycled PET prices; growing demand for recycled PET among a variety of different end-users; continuing strong Chinese demand for California PET; and an influx of PET reclaiming capacity in California, stimulated by strong PET market conditions and the DOR's Market Development and Expansion Grant Program.

A. Market Dynamics

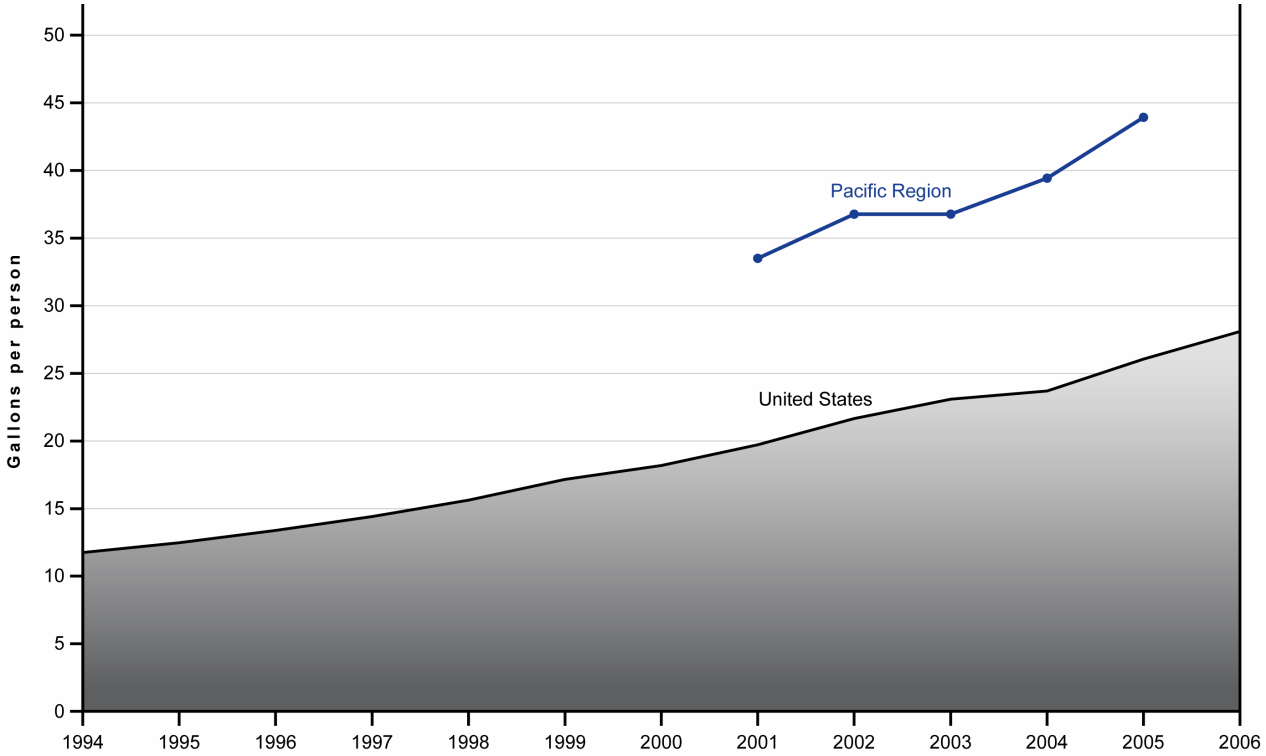
The market dynamics of both virgin and recycled PET are constantly changing. Furthermore, market issues are both global and localized. California has a unique market environment when it comes to PET, but the State operates within the context of global markets for virgin and recycled PET. The key changes in PET recycling are: (1) continued high prices for virgin PET; (2) evolving demand for PET; (3) continued strong exports of California PET to China; (3) high prices and demand for California recycled PET bales; (4) declining prices for recycled PET flake; (5) increased demand for recycled PET by a variety of end-users; (6) slowly increasing recycling rates for CRV PET. We introduce each of these dynamics below, and discuss market issues and barriers created by these factors in subsection D.

1. High Prices for Virgin PET

The price of virgin PET resin is determined by market dynamics at the national and global levels. Despite analyst predictions over the last few years of an inevitable decline in virgin PET prices, the price of virgin PET has remained high into 2007, driven primarily by the high price of gasoline. Virgin PET and gasoline production compete for the same petroleum precursor, paraxylene. Thus, as long as gasoline prices remain high, then virgin PET prices will remain high. One industry analyst noted, "as the price of gasoline goes, so goes the price of PET." The statement could be extended: as the price of virgin PET goes, so goes the price of recycled PET bales. In general, high virgin PET prices also allow PET reclaimers to charge higher prices for recycled PET flakes that they produce.

High virgin PET prices are expected to continue, even though supply is expanding. This dynamic is somewhat counterintuitive. However, the virgin PET resin industry is very competitive, and operates on a low margin. Virgin PET prices are based on the cost of raw materials and operating expenses. Virgin prices will not drop below the cash cost of production, even if there is a surplus of virgin PET. Thus, as long as gas prices (and petroleum raw material prices) are high, virgin PET prices will remain high, even

Exhibit 4-1
Bottled Water – Per Capita Consumption in Gallons/Person



when there is excess supply. Further complicating virgin PET pricing, in Spring 2007 there was a shortage of another PET precursor, isothalic acid, which slowed virgin production. Once isothalic acid production is back at normal levels, analysts expect that there will be a large volume of virgin PET on the market (given expansion at several North American PET producers), but still at relatively high prices.

2. Demand for PET Packaging

PET bottle sales in the United States have grown significantly, driven in large part by the demand for bottled water. The National Association for PET Container Resources (NAPCOR) reported that there were 1,950 million pounds of PET bottles on U.S. store shelves in 1995, and 5,075 million pounds in 2005, a 160 percent increase. Sales of PET CRV containers in California have increased an average of 16 percent a year since 2000. **Exhibit 4-1**, above, illustrates the staggering growth in bottled water sales in the United States, and the higher-than-average bottled water sales in the Pacific region. Nationally, sales of bottled water increased from 3.8 billion units in 1997, to 29.8 billion units in 2007. The vast majority of those containers were one liter in size or smaller PET bottles.

While national and California growth in PET bottle sales has been rapid over the last several years, some expect that growth will slow somewhat as the water market is saturated. This doesn't mean that PET bottles will decline, but that growth will perhaps drop to a mid-single digit figure, rather than double digits. In addition, there is starting to be a bottled water backlash, as consumer advocates,

the State legislature, and a growing number of individuals are questioning why Americans spend over $12 billion a year on bottled water.

Even as PET bottle sales may be slowing, growth in other PET packaging, such as thermoformed containers, is booming. The thermoforming industry, which produces clear and colored clamshell packaging, trays, and containers for food and other products from plastic sheet, has historically been a fairly small component of the PET packaging industry. Recently, thermoforming use of PET sheet has increased significantly, replacing polystyrene (PS #6) or polyvinyl chloride (PVC #3) which have less environmentally-friendly images.

Overall, industry analysts expect global PET demand to grow at a rate of just over 7 percent a year between 2006 and 2011. With 2006 global PET capacity at 35 billion pounds, growth is expected to exceed capacity. In addition, most new virgin PET production capacity is expected to be built in Asia and the Middle East. Mike Schedler of NAPCOR believes this shift "will put more pressure on the domestic recycling industry to increase collection and reclamation."[7]

3. Demand for Recycled PET

Demand for recycled PET is at all-time high levels, with manufacturers of a variety of different end-use applications interested in shifting some production from virgin to recycled content. A wide range of other end-use product manufacturers are interested in recycled PET including: carpets, filters, clothing, fabrics, roofing, paintbrushes, and brooms. David Cornell of Association of Postconsumer Plastics Recyclers (APR) believes that nationally, the demand for recycled PET could more than double, from the current 1 billion pounds per year, to between 2 and 2.5 billion pounds per year.

This increased interest in using recycled PET is economically driven – in the last year, manufacturers of PET products that are using recycled PET obtained huge cost advantages, as much as 40 cents per pound, over manufacturers that used virgin. Demand for PET by the fiber industry in the United States, which had been declining over the last several years, has also seen a recent increase. Over one-half of recycled PET in the United States is used by the fiber industry.

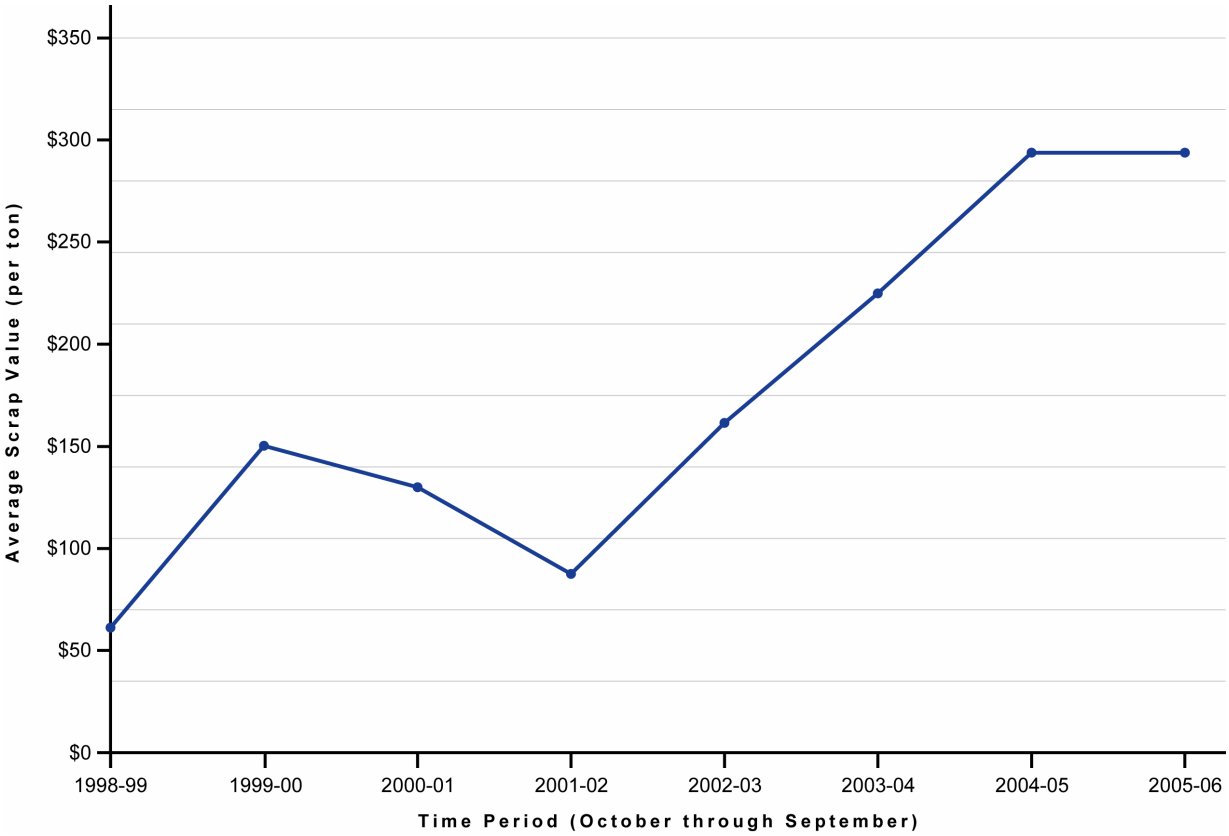
Price appears to be the driving factor in increased use of recycled PET, however there is also growing interest in using recycled PET among end-users for environmental reasons. Wal-Mart's packaging sustainability initiative may be motivating some packaging producers to shift away from polystyrene and PVC, and toward recycled content PET. Environmentally conscious retailers such as Whole Foods are also driving increased use of recycled PET, as well as the corn-based bio-resin polyactic acid (PLA).

California's Rigid Plastic Packaging Container (RPPC) law, which requires that non-food plastic packaging be source reduced, reused, or contain 25 percent recycled content, also increases demand for recycled PET, particularly by the thermoforming industry. Stricter enforcement of the RPPC law by the California Integrated Waste Management Board (CIWMB) would further increase recycled PET demand.

Two examples contrast the ups and downs of recycled PET markets. In 2005 and early 2006, use of recycled PET in strapping was growing at a rapid pace, with recycled PET strapping replacing steel strapping. Today, the PET strapping market has calmed considerably, due to the declining housing industry. By comparison, recycled PET sheet for thermoformed packaging is increasing. The sheet industry is purchasing significant volumes of recycled PET to produce thermoformed containers. Thermoformers prefer to use recycled PET because of the price preference as compared to virgin PET.

[7] Plastics Recycling News, electronic newsletter, March 16, 2007.

Exhibit 4-2
PET Scrap Values, 1998 to 2006



4. High Prices for Recycled PET Bales and Low Prices for Recycled PET Flake

The price of recycled PET bales in California has been at sustained high levels since mid-2005. **Exhibit 4-2**, above, illustrates the steep incline in average scrap values paid by processors in California. Average per pound scrap prices for bales of PET have remained at all-time high levels into 2007. California's recycled PET prices are several cents per pound higher than the rest of the nation, driven by demand from China for California recycled PET.

Even at high bale prices, California recycled PET is in high demand by PET reclaimers in the rest of the country, because of the high quality of the material. California recycled PET has a greater percentage of clear water bottles than other states, and California's long history of recycling PET has resulted in generally higher-standard bales than much of the country.

While California PET bale prices have remained high, the price for recycled PET flake has declined from about 62 cents per pound a few years ago, to about 50 cents per pound in Spring 2007. The reduction in flake price shrinks the margin for reclaimers, as they pay higher-than-average prices for bales, but must sell their product at lower-than-average prices. Imports of recycled PET flake and recycled PET sheet into California from China are driving down flake prices. Illustrating the different market dynamics between California and China, it is less expensive for a broker to purchase California recycled PET,

export it to China, sort, wash, and flake the PET in China, and send it back to California, than it is for a reclaimer located in California to purchase and process the material in-State.

5. Strong California PET Exports to China

China imported an estimated 1.5 billion pounds of PET from all countries in 2006. Overall plastic imports in China grew over 18 percent between 2005 and 2006. The recycling industry in China is large, with about 20 billion pounds of plastic being recycled internally, and another 10 billion pounds coming from other countries. An estimated 30 percent of recycled plastic imports to China come from the United States. China expects to double plastic scrap demand every four to five years, although over time, more material may come from within China.

There are as many as 60,000 recycling companies in China, ranging from home workshops to large, high-tech operations. There has been increased publicity over recycling practices in China, heightened by the Nanhei Event, a news report by the BBC illustrating poor working conditions and pollution at Chinese recycling facilities. China is reportedly implementing and enforcing stricter environmental standards. There is mixed enforcement of a questionable law that prohibits importing whole (baled) bottles, and reportedly many whole bottles come into the country through Hong Kong. Stricter enforcement of both environmental and import standards by the Chinese government could lead to a reduction in Chinese imports of recycled PET, but for California recycled PET, this has yet to occur.

In 2006, California exported 70 to 80 percent of the PET recycled in the State to China, as much as 250 million pounds of PET. China continues to have a huge appetite for California recycled PET. Even as China is reportedly reducing imports of PET from other parts of the world, they remain a dominant player in California. The high quality of California bales, established long-term relationship with brokers, and proximity of California ports (with empty container ships waiting to return to China), are all contributing factors to China's demand for California recycled PET. Over the last several years, some industry analysts have expected that China would reduce PET imports, replacing their PET needs with virgin and recycled PET generated in China. However, Chinese demand for California recycled PET continues to increase, and some expect that it might be as much as five years before we see a significant decline in China's demand for California recycled PET.

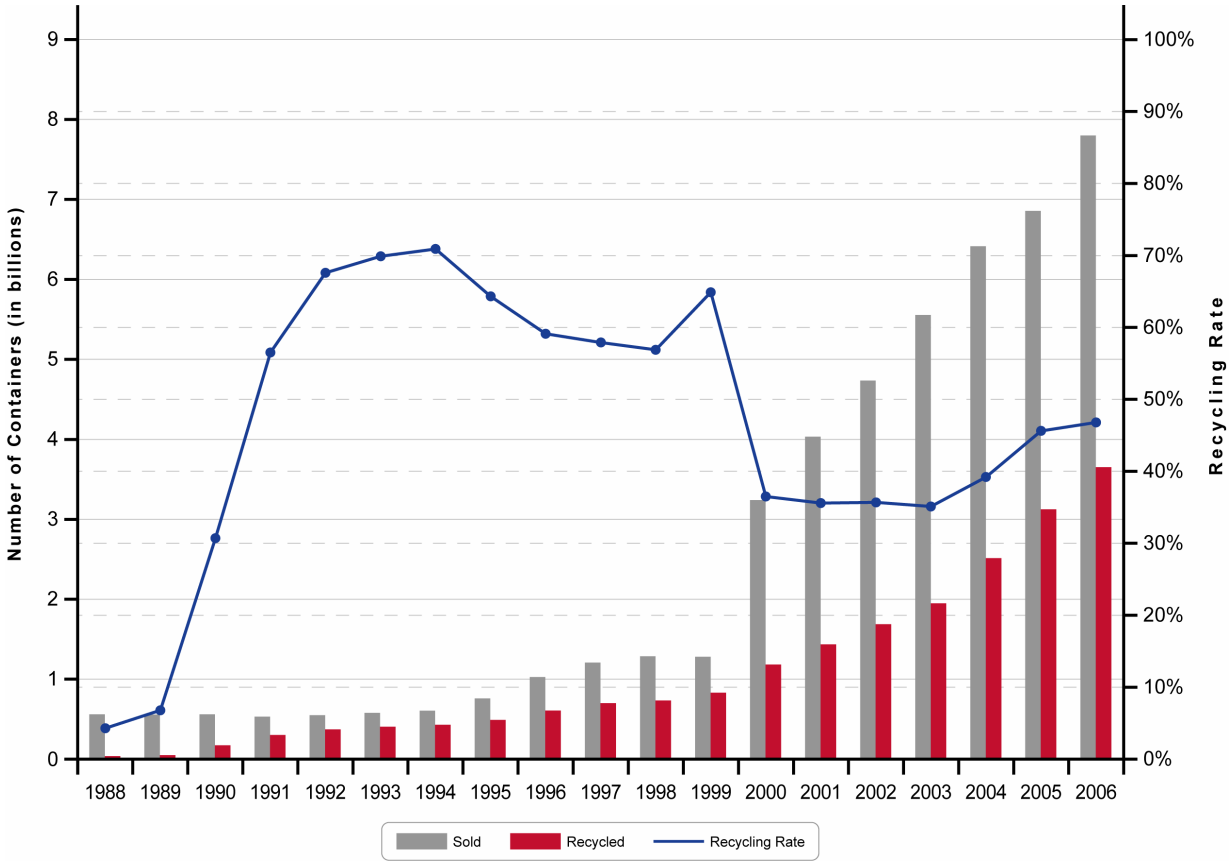
6. PET CRV Recycling Rates and Volumes

Exhibit 4-3, on the next page, illustrates PET sales and recycling in California since 1988. The addition of bottled water, sports drinks, and other beverages to the AB 2020 program in 2000 more than doubled the number of CRV PET containers sold in California. Sales of PET have continued to increase, and are now approaching sales of aluminum. Recycling of PET has lagged behind sales. Quantities of PET recycled have increased each year, however recycling rates are rising much slower, and are the lowest of the four major material types. Some California recyclers report a significant increase in PET recycling levels since January 2007, when CRV payments to consumers increased to 5-cents or 10-cents per container. Still, there is a lack of supply of recycled PET, and in 2006 4 billion PET containers were **not** recycled.

B. Market Players and Capacity

Exhibit 4-4, on page 4-7, illustrates the flow of recycled PET in California in 2006. The vast majority of recycled PET, 91 percent, consists of

Exhibit 4-3
PET Beverage Containers Sold and Recycled, 1988 to 2006



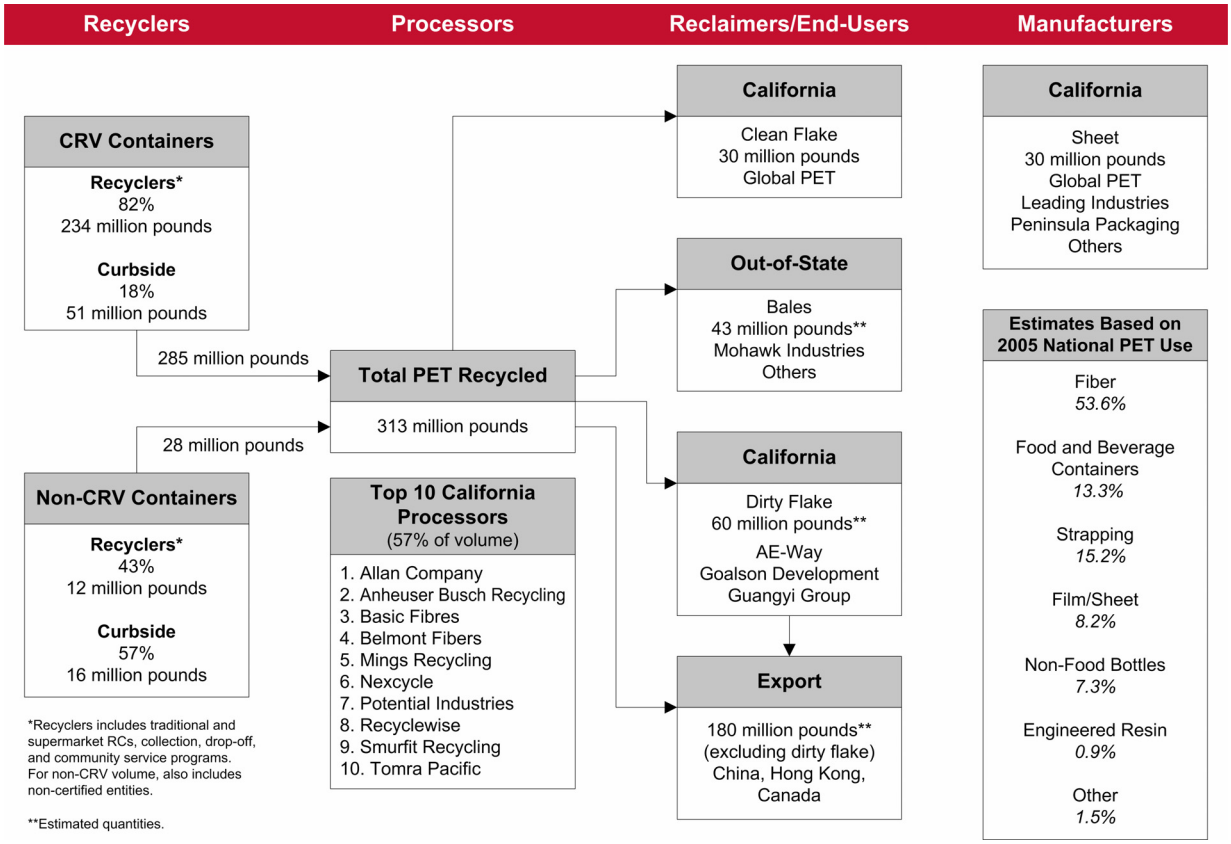
CRV containers. Most PET in California is recycled through buyback recycling centers, with about 22 percent of recycled PET coming through curbside programs. A total of 313 million pounds of PET were recycled in 2006, an increase of 59 percent since 2003, when California recycled 197 million pounds of PET. This is by far the largest recycling increase of any of the beverage container materials.

The top ten processors in California handle 57 percent of PET recycled statewide. Processors sell recycled PET bales to brokers for export, to out-of-state reclaimers, or within California where it is further processed into clean or dirty PET flake.

California's market for PET reclaiming has developed in the last few years, and is expected to expand even more in the near future. Until recently, recycled PET generated in California was not used in California. Instead, California recycled PET was either exported, primarily to China, or shipped to domestic PET reclaimers in the Southeast. Previous attempts to establish PET reclaiming operations in California had failed, for a variety of reasons.

In 2006, Global PET was the lone PET reclaimer in California that produced clean PET flake, primarily for sale to the sheet/thermoforming industry. Global PET, located in Southern California, has received three Market Development and Expansion Grants to assist in developing washed flake, and then sheet, capacity.

Exhibit 4-4
PET Recycling and End-Uses in California, 2006



The primary domestic market for recycled PET is carpet manufacturer Mohawk Industries. Mohawk purchases approximately 40 million pounds of California recycled PET a year. Mohawk purchases California recycled PET, paying the higher price and freight costs (about 6 cents per pound), because California provides a consistent source of high quality PET. The decline in the housing industry, and resulting management changes at Mohawk, may lead to changes in Mohawk's purchasing patterns for California PET in the long term, but in the near future Mohawk remains a strong market player.

Fiber continues to be the dominant end-use for recycled PET, primarily in the form of carpet. Strapping is the next most common market for recycled PET, although that market is reportedly declining along with the housing market. Use of recycled PET in food and beverage containers dropped somewhat between 2004 and 2005, but was 115 million pounds nationally. Graham Packaging received a DOR grant in 2006/2007, and is installing two melt filtration lines in a Modesto bottle-making plant that will use about 2 million pounds per year of clean PET flake. Recycled PET use in sheet and film products increased between 2004 and 2005, and is likely to show increases again in 2006 and 2007.

An estimated 70 to 80 percent of California recycled PET is exported, primarily to China (often through Hong Kong). Approximately 60 million pounds of recycled PET was sorted and ground in California and then exported as dirty flake, however the majority of California recycled PET is exported

as bales. Freight costs to China for PET are minimal – as low as 1 cent per pound – due to the large number of container ships returning to China empty after delivering products to California ports. Some California recycled PET is also exported to Merlin Plastics in Canada.

PET reclaiming in California is evolving rapidly. As of May 2007, two PET reclaimers (one established and one just starting operations) are producing clean (washed) PET flake. There are several more operators in various stages of development, ranging from the drawing board to nearly operational. In addition, there are three companies that are currently producing dirty PET flake (unwashed), for export to China. Below, we discuss the major players, or potential players, in California's recycled PET markets.

1. Current Market Players

Global PET – Global PET sorts, grinds, and washes PET in Perris, California. Current capacity is 30 million pounds per year. The facility recently opened up a sheet production line to utilize 20 million pounds of the **clean flake** produced, and they are adding a green sheet line that will allow them to produce 30 million pounds of sheet in total. Global PET's owner has been managing and operating PET recycling facilities in California since the early days of AB 2020.

AE-Way, Inc. – This company, which began operations in June 2006, is currently grinding PET for export to China as **dirty flake.** AE-Way is grinding two to five loads of PET (30,000 pounds each) per week. They may increase capacity in the future, particularly as their equipment is stabilized.

ECO_2 Plastics (formerly ITEC) – This company, located in Riverbank, developed a dry-wash system utilizing carbon dioxide for recycled HDPE bottles, and is seeking to apply this same mechanism to recycled PET. There have been some questions as to the technical capabilities of this system for **clean flake** PET, although as of Spring 2007, ECO_2 was reportedly purchasing and cleaning PET bales. The company is also considering expanding operations into Southern California. The eventual capacity of the Riverbank facility may be as high as 24 million pounds per year.

Goalson Development Corporation – Goalson, the only PET reclaimer in Northern California, currently sorts and grinds PET for export as **dirty flake.** The company has received a grant to install washing capacity, and expects to be producing clean flake for California markets, perhaps in 2007. Goalson has been operating for ten years, recycling a variety of pre- and post-consumer plastics. Goalson is currently importing clean flake from China, although they expect to stop this practice once they are producing clean flake themselves. Goalson's cleaning operations have been delayed by permitting difficulties, and as of Spring 2007, their cleaning line is not yet operational.

Guangyi Group – This company is an export company. It currently sorts and grinds PET for export to China as **dirty flake.** Guangyi Group exports directly to a fiber mill in Ningbo, China. The mill produces fiber for the automotive, toy, and clothing industries for use in China. Guangyi Group has been exporting post-consumer PET for about one year, previously the company focused on recycling post-industrial plastic.

2. Near-Future Market Players

Allan Company – Allan Company operates one of the largest recycling/processing companies in the State, with facilities from Fresno to San Diego. After receiving two DOR grants, Allan Company is expanding operations to produce **clean flake,** as well as sheet at a washing facility to be located in Pomona. The company is also

considering producing food-grade PET. The facility was slowed by permitting delays, but is moving forward. Because Allan Company operates a large network of recycling facilities, they will be sourcing their recycled PET from their own facilities.

Greenpoint Industries – Greenpoint is a new company located in Rancho Domingo. They are currently testing their equipment, and hope to begin sorting, grinding, and washing PET for **clean flake** California markets sometime in 2007. Greenpoint Industries was also delayed by permitting problems.

New Earth Systems – This Utah-based environmental technology company is building a closed-loop PET recycling operation in Orange County. Their approach combines plastics recycling and wastewater remediation technologies, recycling much of the water that is used to clean the plastic. New Earth System will produce **clean flake** PET.

P.E.T. LLC – This company had received a DOR grant through PRCC for a facility to produce solid state recycled PET for bottle-to-bottle applications, however they were not able to utilize grant funding. PET LLC is reportedly still moving ahead to obtain financing for the 60 million pound per year bottle-to-bottle facility, to be located in Modesto. This is currently the only proposed facility to provide PET bottle-to-bottle recycling in California, although other companies are interested in doing so. The PET LLC facility could be operational by 2009, if financing is obtained.

3. Interested Market Players

Merlin Plastics – Located in Vancouver and Calgary, Merlin operates two reclaiming facilities, one for HDPE and one for PET, with capacity for 50 million pounds per year at each. Merlin has a patented processing technology, and capability to produce food-grade PET in their Calgary plant. Merlin currently purchases PET bales from Canada, Washington, Oregon, and Northern California. They sell some clean recycled PET flake back into the California sheet industry. Merlin has applied for DOR grants in the past, and is interested in siting a facility in California to produce **clean flake** and/or **bottle-to-bottle**, thus avoiding the transportation cost of shipping PET out of, and back into, California.

Plastipak Packaging, Inc. – One of the largest plastic packaging companies in the country, Plastipak is opening a bottle manufacturing plant in Modesto to produce both PET and HDPE bottles. They are reportedly considering the addition of washing and flaking lines for **bottle-to-bottle** PET, HDPE, or both, to feed into their bottle production lines in Modesto. Plastipak's recycling affiliate, Clean Tech, processes 85 million pounds of recycled PET food-grade resin in the Midwest. In several manufacturing locations, Plastipak successfully utilizes a production model that integrates recycling and bottle-manufacturing processes.

Reterra Plastics – this Houston-based plastic reclaimer is reportedly interested in siting an operation in California, likely for **clean flake**.

4. Current and Future PET Reclaiming Capacity in California

While many uncertainties remain, it is clear that California PET reclaiming capacity will grow in the next few years, to the point of exceeding supply. **Exhibit 4-5**, on the next page, provides current and expected 2010 capacity. Note that many of the quantity figures are estimates, and that start-up of some operations still depends on permitting and/or financing. In addition, some of the companies identified in Exhibit 4-5 may not succeed, and others, such as the interested future market players listed above,

or as yet unknown market players, may enter the market. Even with a significant 40 percent increase in recycling[8] assumed between 2006 and 2010, there could be an estimated 100 million pound shortfall in recycled PET in California by 2010. The shortfall is conservative, as the estimated future reclaiming capacity does not include quantities for the interested future market players, and assumes that PET exports to China will decrease by 50 million pounds. In addition, some California thermoformers are considering adding capacity to produce their own clean recycled PET flake. Clearly, if current plans for PET reclamation come to fruition, California is moving toward over-saturation of PET reclaiming capacity.

Estimates for California clean flake, sheet, and bottle-grade PET production may evolve over time, as companies adjust their business plans to fit market conditions. While producing sheet appeared to be a strong market a year ago, the California sheet market has become near-saturated by backwards integrated thermoformers (producing their own sheet), so demand for sheet has dropped considerably. As a result, California reclaimers are looking to move into thermoforming themselves, or producing higher-end food-grade recycled PET. These market dynamics will continue to evolve over time, thus, by 2010, the recycled PET market landscape could look much different.

C. New Alternatives

There are a number of "new" alternatives for recycled PET. Some are simply expansions or continued development of existing technologies, while some are new applications that have not yet been commercialized.

Bottle-to-bottle PET recycling is not a new alternative, however there continue to be developments in this area. Several years ago, Coca Cola and Pepsi both agreed to utilize 10 percent recycled PET in their bottles in the United States. Coca Cola uses recycled PET in 13 countries, "with no adverse effect on product sales or quality".[9] Coca Cola is looking to expand reprocessing facilities, and Cola UK Branch is increasing use of recycled PET in bottles. A company representative estimates the maximum recycled content the bottles could use is 50 percent, which is much higher than current levels in the United States. Baylis Recycling in the UK is making 33 million pounds per year of PET bottle preforms (the precursor to PET bottles) with 35 percent recycled content.

The State should consider either encouraging or requiring the large soft drink, bottled water, and sports drink manufacturers (i.e. Coca Cola and Pepsi) to increase utilization of recycled content in their containers beyond the current minimal level of 10 percent. PET bottles sold in the United States could have a higher recycled content level. While there are many other end-uses for recycled PET, bottle-to-bottle recycling provides a sustainable market for beverage containers.

[8] This estimate is based on a 10 percent per year increase in PET recycling (averaging actual increases of the last two years).

[9] Plastics Recycling News, February 2007.

Exhibit 4-5

Comparison of 2006 PET and Estimated 2010 PET Reclaiming Capacity

Actual 2006 (in millions of pounds)	PET Reclaiming and/or End-Use	Estimated 2010 (in millions of pounds)	Change
180*	**Export (Bales)** China, Hong Kong, Canada	120*	↓
60*	**Export (Dirty Flake)** China (AE-Way, Goalson, Guangyi)	80*	↑
20	**Clean Flake** (Global PET, Allan Co., ECO_2, Greenpoint, Goalson, New Earth Systems, others?)	190*	↑
10	**Sheet/Thermoforming** (Global PET, Allan Co., others?)	50*	↑
–	**Bottle Grade** (PET LLC, others?)	60*	↑
43*	**Domestic U.S. Reclaimers** (Mohawk)	40*	↓
313	Total Reclaimed	540	↑
313	Total Recycled	440	↑
–	Supply Shortfall	100	

**Estimated quantities.*

Optical sorting technology is another area with new development potential. Most plastic reclaimers now utilize optical sorting technology, either at the bottle or flake level, as part of their process. Automated sorting technology has developed since the late 1990s, and now offers a "fast, efficient, and accurate" way to sort plastic bottles. Technologies utilize x-rays, Near-Infrared sensors, and vision systems (color cameras) to sort based on color and chemical composition. Several equipment manufacturers have systems of varying sizes, speeds, and sorting capabilities, including MSS, a division of CP Manufacturing in National City, California. MSS has several different systems that are being used in the US.

On a laboratory scale, North Carolina State University (NCSU) chemical engineers have developed a new chemical recycling process to create food grade PET using depolymerization into oligomers. The process breaks apart the PET

with ethylene glycol. Once the plastic is broken down, any solid, liquid or vapor impurities are removed. Finally, the oligomers are repolymerized into PET. The process runs continuously in a twin-screw extruder, is energy efficient and can handle high volumes. A commercial company, DPoly Systems, is working with NCSU to commercialize the process.

Recycled PET can also be used to form high-value compounded resins. GE Plastics has developed a promising technology to produce composite resins for auto manufacturing. The resins, Valox iQ and Xenoy iQ, contain 85 percent post-consumer PET. Recycled PET is broken down to oligomer level, and then used to produce the new resin. The resins replace PBT (polybutyrate terephthalate), and could use up to 1.2 billion pounds of recycled PET, more than is currently recycled nationally. The compound resin can be used in automotive handles, trim components, and connectors. A major advantage of this alternative is that the manufactured resin sells for $2 per pound, several times more than prices for recycled PET flake or pellets. GE Plastics is currently up for sale, which may delay full-scale production of these resins.

About 30 percent of recycled PET is now colored – typically green, amber, and blue bottles. There are fewer end-markets for this material. Clean Agency received a DOR grant in 2006/2007 to develop a recycled PET transport package using colored PET. A potentially significant end-use for recycled PET is being developed by Evco Research, in Georgia. Evco uses recycled PET as a coating for corrugated packaging, replacing wax. The boxes are reportedly recyclable. Another company has developed a mining bolt that utilizes colored PET, and is commercializing the product on the East Coast.

D. Market Issues and Barriers

There are many key market issues and barriers for California recycled PET markets. Among the most critical issues are: (1) potential overcapacity for clean flake and sheet; (2) continued high exports to China; (3) China's role in clean flake and sheet markets; (4) high prices for PET bales; and (5) growing use of bio-resins (polyactic acid, PLA), colored PET, and additives. The first four market issues are closely related, reflecting dynamics between price, supply, and demand. We discuss each of these issues below.

As Exhibit 4-5 shows, California could soon be overwhelmed with reclaiming capacity for clean PET flake. There are many problems that could result from this condition. First, there will not be enough recycled PET to go around. California PET reclaimers will have to choose between operating below capacity, or bidding up the price of recycled PET bales to meet capacity.[10] Either choice will place a significant economic burden on California PET reclaimers; it is possible that some reclaimers could go out of business. Furthermore, the existing Chinese export and domestic PET markets will not simply evaporate to make room for new California PET reclaiming capacity.

One strategy that PET reclaimers have used to help address the oversupply of clean flake is to move further up the supply chain towards producing final end products. The addition of sheet lines at California PET reclaiming facilities such as Global PET is an example of this strategy.

The market for recycled PET sheet is changing. There are a number of thermoforming operations in California, including Leading Industries, Peninsula Packaging Company, PWP, and Pactiv, that are actively using recycled PET. Recycled PET

[10] This is essentially what is has been happening for several years with HDPE, where there is not enough supply to meet the needs of California's three HDPE reclaimers, particularly given the strong export market.

sheet is used by the California thermoforming industry to produce PET packaging such as clamshells, trays, and baskets. While these companies started out buying large quantities of recycled PET sheet, many have installed sheet extrusion lines, and are now producing their own recycled PET sheet.

The thermoform packaging industry operates on very slim profit margins, and will take whatever steps they deem necessary to lower operating costs, be it purchase recycled PET sheet, or produce their own recycled PET sheet. Because of this recent backwards integration by thermoformers, it has been increasingly difficult to find markets in California for recycled PET sheet. Global PET, who received a DOR grant for a recycled PET sheet line, is currently struggling to find buyers for their sheet.

China is exporting clean recycled PET flake and recycled PET sheet into California. China's export of recycled PET flake and sheet is driving market prices for these commodities down, reducing the margin for PET reclaimers in California. The situation is particularly frustrating for California PET reclaimers, because China's import demand for recycled PET bales from California drives their raw material (bale) price up, and at the same time China's export of recycled PET flake and sheet into California drives their final product prices down. Clearly, Chinese companies are operating on a fundamentally different pricing system when it costs less to ship PET bales from California, to China, and back to California as a product, than it costs for California PET reclaimers to make the same product in California.

China continues to import a significant quantity of California recycled PET, either in the form of bales or dirty flake. China's strong position in California's PET market drives recycled PET prices several cents per pound higher in California than the rest of the country. The high PET bale prices in California are advantageous for recyclers, as it is easy to find buyers, and to obtain top dollar for their material. However, the high price of bales is difficult for California and domestic reclaimers, as they must meet the high prices set by China in order to purchase recycled PET bales. It is particularly costly for PET reclaimers located in the Southeastern United States, such as Mohawk Industries, because they incur about 6 cents per pound in freight charges to ship California material to their facilities. To date, Mohawk has been willing to pay the premium for California PET, because it is high quality material. The freight costs to China are extremely low, at approximately 1-cent per pound. This is less than it costs to ship recycled PET from Northern to Southern California.

Another set of interrelated PET market issues results from the growth of bio-resin containers, and increased use of additives, multilayers, barriers, and colors in PET (and other plastic)containers. The carefully defined legacy plastics #1 to #7 resin code system, developed after much discussion in the 1990s, is becoming less and less applicable to today's plastic containers. As more PET bottles contain additives, it creates challenges for recyclers, processors, and reclaimers. While additives and barriers may have advantages at the manufacturing level, they are often contaminants in the recycling stream, adding processing costs and reducing quality.

E. Grant Opportunities and Recommendations

There are three key areas, described below, in which grants could improve market conditions for recycled PET in California. These recommendations do not include further grant funding to provide new PET clean flake-only reclamation capacity in California at this time. There are simply too many pending clean flake projects to justify spending additional State dollars in this area.

1. *Support Development of Recycled PET End-Products*

If California PET reclaimers are going to be producing significant quantities of clean PET flake, end-markets for this material are important. Projects that help ensure end-use markets, and/or improve opportunities for end-user markets will be critical. Encouraging end-use conversion of recycled PET flake to final products will act to drive material through the system, as well as strengthen previous investments in reclamation capacity.

There are several opportunities to improve end-use markets for recycled PET. One option is to expand from sheet production into thermoforming. Producing food-grade recycled PET sheet is another area that may provide strong end-use markets. The federal Food and Drug Administration (FDA) has defined several categories of food-grade recycled PET, ranging from produce-grade to bottle-to-bottle grade. Reclaimers need to obtain a letter of non-objection from the FDA to certify that their product meets the appropriate standard. Food-grade recycled PET can demand higher prices. Furthermore because producing food-grade PET has greater barriers to entry, it is less likely that thermoformers will produce food-grade PET themselves.

The Grant Program could also support production of bottle-to-bottle grade recycled PET. Producing FDA approved bottle-to-bottle grade PET is costly, however the recycled resin end-product demands a higher price. If Coca Cola and Pepsi actually utilized recycled PET at the 50 percent level that they state is technically feasible, it would create a huge market for bottle-to-bottle grade recycled PET in California and elsewhere.

In addition to established end-uses such as thermoformed packaging, strapping, fiber, and bottles, there are some new technologies that could provide new end-use markets for recycled PET. There are potential high-cost technical options such as the GE Plastics resins described above, as well as lower-tech and lower-cost options such as the PET/corrugated packaging developed by Evco. The DOR should carefully evaluate and consider any proposals for new PET end uses to ensure that they are technically and economically viable. As one analyst said, look for "good science by people that never fool themselves."

There are also potential grant opportunities to support end-use markets for green, amber, and blue colored PET. Colored PET resins now make up almost one-third of the PET recycling stream. There are few markets for these materials, and reclaimers lose money on the material. Promoting end-use alternatives that utilize colored PET would provide focused help in an area in which the market is not currently functioning.

2. *Research on Barrier Layers, Polyactic Acid (PLA) and Resin Codes*

There are grant opportunities related to the growing use of PLA, barrier layers, colors, and other additives in plastic containers. The distinction between the seven plastic resins is getting murkier, as bottle manufacturers rely on additives to change the properties of resins. Many applications that use PET bottles, for example PET beer bottles, require special barriers or multi-layers, creating problems for recycling. To this point, the percentage of these modified resin bottles has been small. However, the use of additives and multilayers is growing, and will become increasingly problematic for recyclers. Scientific research on impacts of various additives and barriers on recycling, the need to redefine resin codes as various chemicals are added to resins, and the impact of bio-resins on recycling, would be beneficial now, before these issues become more severe.

For PET recycling, the growing use of PLA must be addressed in the near term. PLA is a corn-based

plastic resin that can be used in many of the same applications as PET. Whole Foods and other retailers are encouraging suppliers to utilize bio-resins such as PLA. *Plastics Recycling Update* recently completed a survey of major North American PET reclaimers, and over 50 percent said they have received PET bales contaminated with PLA. PLA causes operational problems in drying, melting, and solid-stating of recovered PET. Reclaimers currently do not have equipment to identify and remove bio-plastic bottles. APR and others are discouraging bottle-manufacturers from using PLA as a replacement for PET bottles until issues surrounding coding and recycling these bottles are addressed. However, PLA sales are increasing nationally. Natureworks LLC, based in Minnesota sold more PLA in the first quarter of 2006 than they did in all of 2005.

3. Increase Collection and Recycling of PET Containers

In 2006, over 4 billion PET containers were landfilled, or littered and swept through the storm drains into the ocean. This represents an astounding loss of resources, from both an economic and environmental perspective. The DOC should consider opportunities to improve collection, processing, sorting, automated sorting, removing beverage containers from MRFs and landfills, and increasing consumer's opportunities and incentives to recycle.

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5. HDPE

HDPE became part of the AB 2020 program in 2000, with the addition of juice, sports drinks, water, coffee, and tea. Prior to 2000, HDPE containers were commonly recycled through curbside programs, and that continues to be the major recycling method for HDPE. The most common HDPE container is milk jugs, which are not currently within the AB 2020 program. California has three HDPE reclaimers that utilize recycled HDPE to produce recycled content pellets, or to directly produce recycled content products. The predominant market issue for recycled HDPE is lack of supply, a condition which has been aggravated by growing export of California recycled HDPE to China.

A. Market Dynamics

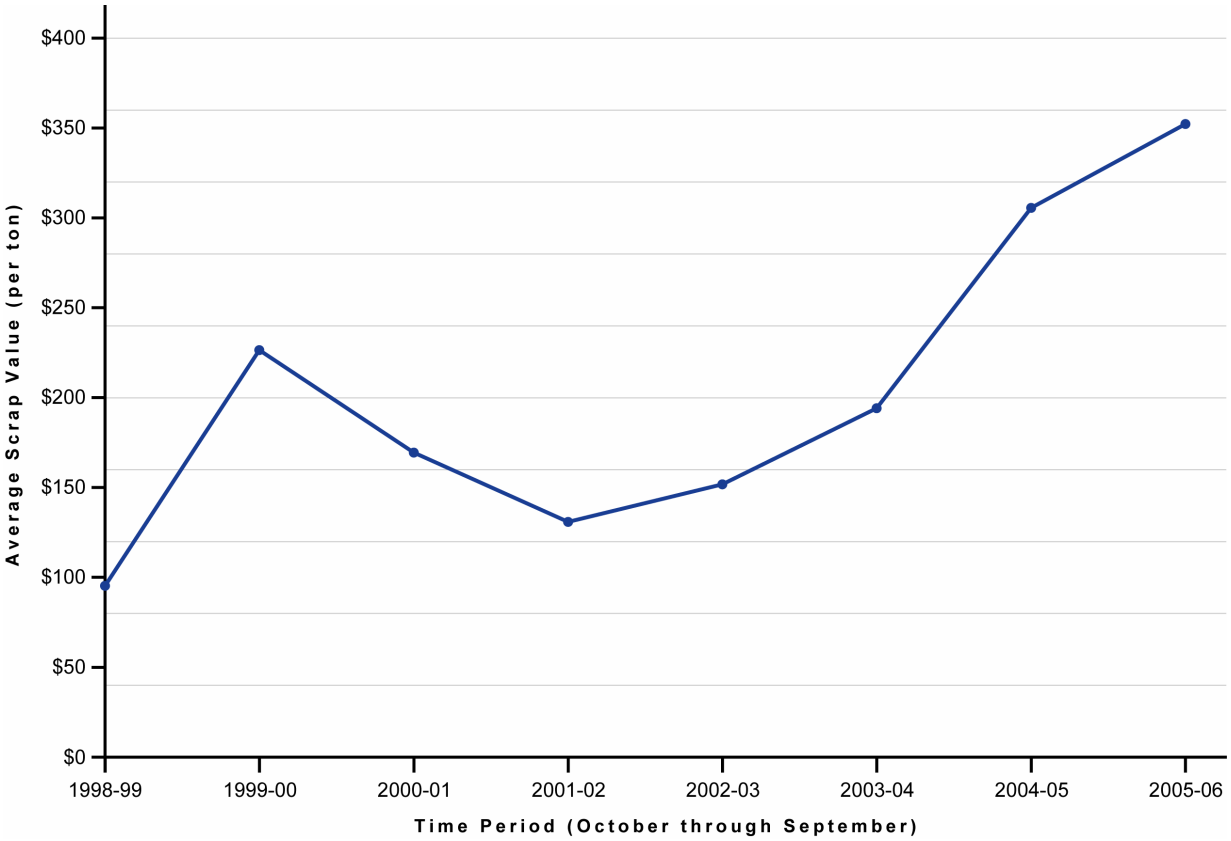
While recycled HDPE markets are not as dynamic as those for recycled PET, there have still been a number of changes in the last few years. The key changes in HDPE recycling are: (1) increased exports to China, (2) continued high prices for recycled HDPE, (3) increased demand for recycled HDPE among end-users, (4) a decline in total HDPE bottle production, and (5) a lack of supply of recycled HDPE. We introduce each of these dynamics below, and discuss market issues and barriers created by these factors in subsection D.

1. Increased Export to China

China's imports of recycled plastic increased over 18 percent between 2005 and 2006. China imported a total of approximately 3.5 billion pounds of HDPE in 2006, including container and film HDPE from all countries. Combined low density and high density polyethylene exports from the United States increased 27.9 percent between 2005 and 2006, to a total of 757 million pounds. Exports of HDPE bottles from the United States in 2005 totaled 162.4 million pounds. The majority of these exports are to China.

Because of California's proximity to the Pacific Rim, and active ports, China has always been a force in HDPE markets. Historically, China would buy California recycled HDPE for a few months, increasing the price of bales, and then leave the market. Each time China entered the market, they would upset the market balance and increase the price. However, in the last eighteen months, China has simply stayed in the HDPE market, becoming a steady and strong force in California's recycled HDPE market.

Exhibit 5-1
HDPE Scrap Values, 1998 to 2006



2. *High Scrap Values for Recycled HDPE*

Like PET, scrap prices for HDPE have been at historic high levels. **Exhibit 5-1**, on the next page, illustrates the average HDPE scrap value paid by processors in California since 1998. Since dipping in 2001/2002, HDPE scrap values have been on an upward trend. These high HDPE scrap values reflect the general high prices for plastic scrap, as well as the strong demand for recycled HDPE.

3. *Increased End-User Demand for Recycled HDPE Resin*

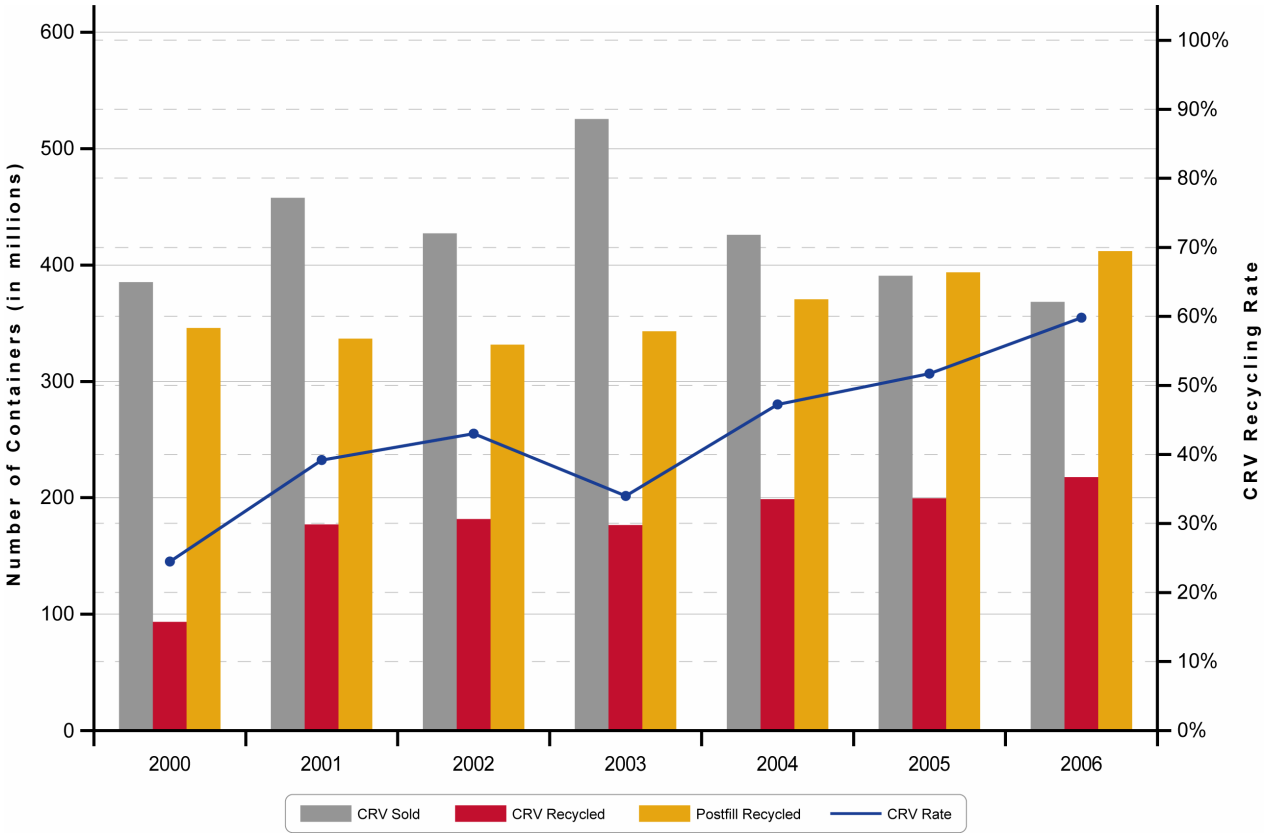
There is growing demand among a wide range of end-users for recycled HDPE. Recycled HDPE can be utilized in a variety of products such as: bottles, pipe, lawn and garden products, film, sheet, lumber, pallets, crates, buckets, and automotive parts. HDPE reclaimers say that they cannot meet their customers' demand for recycled resin, and Scott Saunders of KW Plastics noted that the recycled HDPE market "could grow 100 to 200 percent without affecting the downstream market's ability to absorb that material."[11]

4. *Decline in Total HDPE Bottle Production*

The lack of supply of recycled HDPE has been compounded by a slight downward trend in HDPE bottle production. Between 2004 and

[11] Mike Verespej, "KW finding success by seeking greatness." (Plastics News, May 22, 2006, p.9).

Exhibit 5-2
HDPE Beverage Containers Sold and Recycled and Postfilled* Containers Recycled, 2000 to 2006



**Postfilled containers is the term used for non-CRV containers.*

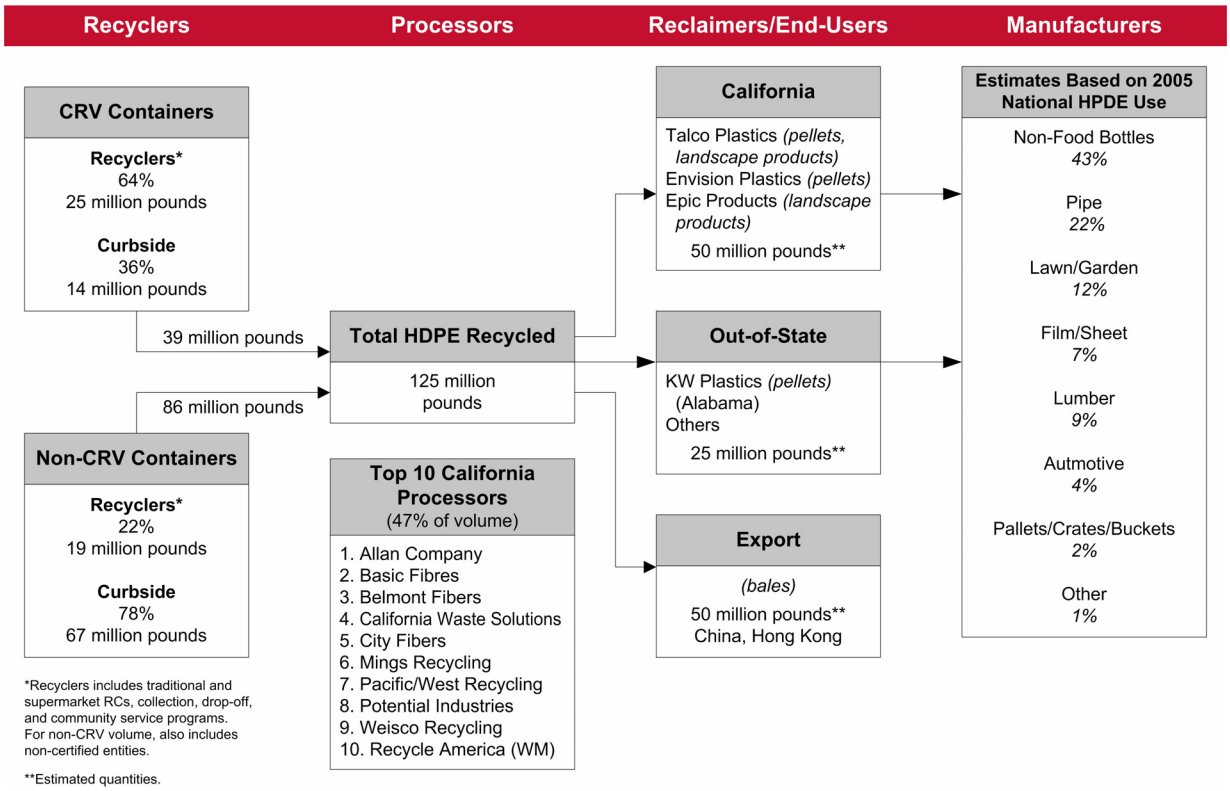
2005, the most recent two years for which data is available, HDPE resin sales for bottles dropped from 3,486 million pounds to 3,404 million pounds. The decline in HDPE bottle production is driven by a move towards selling more household products as concentrates (and thus requiring fewer HDPE containers), lower sales of gallon-size water containers, and the high cost of HDPE resin. HDPE bottle production will continue to drop, as Proctor & Gamble announced in May 2007 that they will convert their liquid detergent to smaller bottles. Proctor & Gamble sells more than 60 percent of all liquid detergents. As the size of the HDPE container market shrinks, it will be even more challenging for reclaimers to obtain enough recycled HDPE.

5. Lack of Supply of HDPE

Of the four major resin types in the beverage recycling program, HDPE is sold and recycled in the lowest volumes. In 2001, only 125 million pounds of HDPE containers were recycled in California, compared to 313 million pounds of PET. Unlike any other recycled beverage container material, 69 percent of California recycled HDPE is non-CRV material, primarily half-gallon and gallon milk containers.

Exhibit 5-2, above, illustrates CRV sales and recycling quantities, non-CRV recycling (postfilled) quantities, and CRV recycling rate for HDPE since 2000. The exhibit illustrates the decline in CRV container sales, and a gradual increase in both CRV and non-CRV recycling,

Exhibit 5-3
HDPE Recycling and End-Uses in California, 2006



over the last few years. In 2006, the HDPE recycling rate for CRV containers was 59 percent, significantly higher than the recycling rate for PET CRV containers. The overall HDPE container recycling rate at the national level was estimated at 27 percent in 2005. California's overall HDPE recycling rate is likely somewhat higher, because of the AB 2020 program. There are still significant quantities of both CRV and non-CRV HDPE that are not being recycled in California.

B. Market Players and Capacity

Exhibit 5-3, above, illustrates the flow of recycled HDPE in California in 2006. More than one-half of all HDPE is collected through curbside programs, reflective of the high percentage of non-CRV containers. The largest ten HDPE processors in California handle about one-half of the HDPE collected in the State. About 40 percent of California's recycled HDPE stays within California for reclaiming and end-use.

The same three (3) companies operate HDPE reclaiming facilities in California as were operating in 2004. One company is integrated into an end-use product (Epic Plastics produces landscape material), while the other two produce recycled HDPE pellets for use by other manufacturers in bottles and durable goods. Much of the HDPE reclaimed in California is used in the State, although export is growing.

California's three HDPE reclaimers still report that they cannot obtain enough recycled HDPE to meet their needs, and to supply all current end-use demand. The three companies operating in California are:

Envision – Envision, located in Chino, is the recycling arm of Ecoplast, Inc., one of the country's largest plastics compounders. Envision produces recycled content pellets to their user's specifications, ranging up to 100 percent recycled content. Envision received two DOR grants, one for optical sorting and to increase capacity to over 30 million pounds per year, and one to install a patented technology to produce food-grade recycled HDPE.

Epic Plastics – Epic Plastics, located in Lodi, produces benderboard and other landscape products utilizing mixed-color HDPE. Epic flakes and washes the HDPE, then utilizes it directly in the extrusion to produce end-products. Epic received a DOR grant to install optical sorting equipment.

Talco Plastics – Talco, located in Long Beach, sorts, grinds, washes, and produces pellets from post-consumer and post-industrial HDPE. The company sells to both the bottle and durable goods industries. Talco has received two DOR grants, and is expanding capacity and increasing efficiency of their operations. Their initial grant expanded capacity for post-consumer HDPE from 18 to 20 million pounds, to 24 to 26 million pounds. The second grant will improve Talco's operational efficiency, and will increase capacity further to 28 to 30 million pounds, in early 2009.

Outside California, KW Plastics utilizes almost one-half of the recycled HDPE generated in the United States each year, and is still a dominant factor in California's HDPE markets, as they were in 2004. KW Plastics is the largest plastic recycler nationwide, with an estimated $223 million in sales. KW Plastics is successful because they operate at very high volumes; have been willing to invest in equipment, including an automated continuous process; and they manage transportation through their own trucking company. KW has capacity to produce 500 million pounds of recycled resin, annually, equally divided between polypropylene (PP) and HDPE. They operate on a large scale, with four shredders, six granulators, 3 wash lines, and nine extrusion lines. There are other domestic HDPE reclaimers that purchase California HDPE, although none in large quantities.

An estimated 40 percent of California recycled HDPE was exported, primarily to China (or to Hong Kong and then China) in 2006. Exports increased over 2003, when the export estimate was less than 30 percent.

The most common end-use for recycled HDPE is for non-food bottles such as detergent, automotive oil, and other household products. Typically, these end-users prefer natural HDPE recycled resin. Natural HDPE is preferred because end-users only need one storage silo, and can easily add dye to the resin to create any different color in their product lines. Colored HDPE is typically utilized in products such as pipe and lawn or garden products.

Exhibit 5-4, on the next page, provides a comparison of 2006 HDPE reclaiming capacity and recycling, with potential current, and future, HDPE reclaiming capacity and recycling. The exhibit shows a shortfall in supply of recycled HDPE of at least 65 million pounds, even with increased recycling to 150 million pounds per year.[12]

Within California, all three current HDPE reclaimers could handle additional quantities of HDPE at current nameplate capacities. KW Plastics, as well as other domestic HDPE reclaimers, could use significantly more California HDPE than they are now, if it were available. The 75 million pound demand estimate for domestic reclaimers in Exhibit 5-4 is very conservative. Reportedly, Plastipak, one of the largest plastic packaging companies in the United States, is considering adding HDPE and/or PET reclaiming

[12] We estimated a 20 percent increase in recycling volumes of HDPE for purposes of illustration, based on increases in HDPE containers recycled continuing at the recent rate of about 5 percent a year.

Exhibit 5-4
Comparison of 2006 HDPE and Potential Current and Future HDPE Reclaiming Capacity

Actual 2006 (in millions of pounds)	End-Use	Potential Current and Future Estimated 2010 (in millions of pounds)	Change
	California HDPE Reclaimers		
50*	Talco Plastics Envision Plastics Epic Plastic	90*	↑
	Domestic U.S. Reclaimers		
25*	KW Plastics Others	75 (or more)*	↑
	Export		
50*	China Hong Kong India	50*	—
125	Total Reclaimed	215*	↑
125	Total Recycled	150*	↑
0	Supply Shortfall	65*	

**Estimated quantities.*

capacity at a new bottle plant in California. At other Plastipak facilities in the Midwest, Plastipak has successfully incorporated recycled plastic into their bottle production.

It is difficult to predict how export markets to China will change over the next four years, so for purposes of Exhibit 5-4, we hold these levels steady. The exhibit illustrates that there is a significant supply shortfall for recycled HDPE. This recycled HDPE shortfall is considerable at current recycling levels, and will still be large even as recycling rates for HDPE increase.

C. New Alternatives

There is not a strong need for new alternatives for recycled HDPE, although new uses are being developed.

TRI/Environmental, Inc., in Austin, Texas, is researching the use of blended recycled and virgin HDPE in corrugated drainage pipe. The industry consumes over 1 billion pounds of virgin HDPE annually, but use of recycled HDPE is limited because there are no contractor specifications for using recycled material. TRI principal investigator Richard Thomas is developing specifications and test methods for using recycled HDPE, which he hopes to complete by Fall 2008. A benefit of this end-use is that it could provide a large market for colored HDPE.

The development of food-grade recycled HDPE is also expanding. Envision Plastics received a market development grant in the 2006/2007 grant cycle to develop a processing line for food-grade HDPE (and PET). There is essentially no food-

grade HDPE being produced in the United States today, in part because there are such strong markets for non-food grade HDPE. However, given the high bale prices for recycled HDPE, food-grade recycled HDPE provides an advantage because it would demand a higher market price, thus increasing the margin for reclaimers.

Nextek Limited of London is expecting FDA approval of an HDPE bottle-to-bottle process. The process includes grinding, hotwashing, color sorting, a decontamination step with a double-vacuum high-temp system, followed by melt-filtering and pelletizing. Costs for a plant are about $5.8 million, according to Ed Kosior of Nextek. A retailer in the UK, Marks & Spencer of London, recently completed a sales trial of 30 percent recycled content HDPE milk containers produced in a closed-loop system. Empty milk containers were collected and sorted, flaked, washed in a warm 2 percent caustic solution, dried, color-sorted, washed again, and then combined with virgin food-grade HDPE to produce a 30 percent recycled content container.

Another new approach for HDPE recycling is being developed by Ohio based Advanced Blending Technology (ABT). Launched in 2002, ABT is a software technology company that helps processors use recycled plastics in place of virgin, using an Optimiser-brand software. The software helps generate the correct mix of recycled resin, based on actual performance characteristics of the resin feedstock. The software can reportedly save between 10 and 35 percent on raw material costs. ABT obtains a licensing fee for each pound of material produced using their software and blending technology.

D. Market Issues and Barriers

There are five key market issues and barriers for recycled HDPE markets. Four issues are closely interrelated: (1) increased demand for recycled HDPE from China, (2) high prices for recycled HDPE, (3) low quality of recycled HDPE bales, and (4) lack of supply of recycled HDPE. A fifth, and unrelated, market issue is the increased use of calcium carbonate and other additives in HDPE containers.

The lack of supply of HDPE has been an ongoing concern for California's three HDPE reclaimers, as well as the national HDPE reclaiming industry. Every market player in the HDPE reclaiming industry could use more material. HDPE reclaimers are operating below capacity. Even if they were operating at capacity, reclaimers could not produce enough recycled HDPE resin to meet the needs of their end-use customers. In order to meet their nameplate capacity, California's HDPE reclaimers would have to bid-up the price of HDPE bales, to the point of making it uneconomical to use recycled HDPE.

The lack of supply of recycled HDPE is compounded by the increase in exports of recycled HDPE to China. China's influence on California's recycled HDPE markets is profound. China controls the price of recycled HDPE bales in California, driving them higher than the rest of the nation. With negligible freight costs to China, and cheap sort-line labor once the bales arrive, Chinese exporters can afford to pay above-market prices. While this is beneficial to recyclers, it creates a significant hardship on HDPE reclaimers. HDPE reclaimers must pay the inflated market-price that Chinese exporters set for their raw material, but reclaimers cannot necessarily recapture that inflated price when they sell recycled HDPE resin pellets to end-users, most of whom are in California.

The price of recycled resin is driven by the price of virgin HDPE. After Hurricane Katrina shut down many resin producers in 2006, virgin HDPE prices rose, creating a solid margin for HDPE reclaimers. Now that HDPE production has increased, both in the United States and globally, HDPE prices are lower. This virgin

HDPE production increase, combined with the high price of recyceld HDPE bales, results in a shrinking margin for domestic HDPE reclaimers.

High prices and strong demand are resulting in declining quality of HDPE bales, particularly colored HDPE bales. Because they have plenty of low-cost labor, Chinese buyers are willing to pay high prices, even for low quality bales. California's colored HDPE bales contain a higher percentage of contaminants than bales from other parts of the country. Expanded single stream curbside programs, and the common MRF practice of throwing colored PET and plastics #3 to #7 containers into colored HDPE bales, has resulted in contamination levels in colored HDPE bales of up to 25 percent.

Under normal market conditions, an inferior product would generate a lower price, but when every reclaimer is struggling to purchase enough raw material, and China is driving prices upwards, even low-quality bales are receiving top dollar. Thus, there is no built-in market incentive for recyclers to provide high quality HDPE bales. This compounds the financial burden on HDPE reclaimers, who are paying top dollar for bales, but can use only 75 percent of the material purchased.

With help from the grant program, all three California HDPE reclaimers are investing, or have invested, in optical sorting technology to address the contamination issue at the back end. Epic Plastics is currently sorting and utilizing the mixed plastics #4 to #7 that they receive in their "HDPE" bales, but they must sort out and separately recycle PET and PVC (#3). Envision has installed an optical sorting system, and Talco Plastics is in the process of installing an optical sorting system to sort and then utilize or recycle non-HDPE plastics coming from HDPE bales. While an optical sorting system significantly improves quality of material, it also slows down production lines, lowering efficiency.

A fifth market issue is the growing use of calcium carbonate and other materials in HDPE. These compounds change the property of HDPE, making it more suitable for certain container applications. However, as the percentage of these materials in HDPE increases there is growing concern from the Association of Postconsumer Plastics Recyclers and others about processing problems.

The addition of calcium carbonate ($CaCO_3$) to HDPE containers has serious implications for HDPE recycling. A Special Report titled, "How do you spell trouble in the HDPE recycling industry? $CaCO_3$" in the April 2007 Plastic Recycling Update describes the problem:

> "A growing trend among bottle-makers, the use of calcium carbonate as a filler in HDPE bottles reduces the amount of petroleum-based material needed to make the products. The problem, however, is that this filler can make recycling HDPE difficult, if not prohibitive, because it alters the specific gravity of the plastic when used in excess. Bottle-makers, however, say the filler saves money on raw materials and is an environmentally friendly way of reducing the industry's reliance on a non-renewable resource…"[13]

The addition of calcium carbonate impacts both HDPE and PET recycling. The standard separation method for these two plastic resins is a float/sink tank. HDPE floats, while PET sinks. Calcium carbonate causes HDPE to sink, leaving the HDPE reclaimer with a lower yield, and the PET reclaimer with HDPE contamination. The Association of Postconsumer Plastic Recyclers is working to educate recyclers and develop strategies to address the issue. They argue that the bottle-maker's environmentally friendly approach to reducing reliance on petroleum is counterproductive when it makes the container less recyclable.

[13] "Special Report: How do you spell trouble for the HDPE recycling industry? $CaCO_3$." (Plastics Recycling Update, April 2007, p.5). This short article is an excerpt from a longer article by Steve Alexander, of Association of Postconsumer Plastic Recyclers that will appear in the May, 2007 issue of *Resource Recycling*.

E. Grant Opportunities and Recommendations

Improving HDPE markets means, first and foremost, increasing the supply of HDPE. There are also opportunities to increase the quality of HDPE collected, and to help make California HDPE reclaimers more competitive with Chinese markets by improving operating efficiency. The grant program has already provided funding to Envision Plastics, Epic Plastics, and Talco Plastics in these areas, however, there may be future opportunities as new technologies and processes are developed.

Another potential focus to improve HDPE markets in California is to help level the playing field with China. Currently, it is extremely difficult for domestic reclaimers to compete with Chinese export markets for recycled HDPE. The market development payments enacted through AB 3056 may provide a competitive boost to help California HDPE reclaimers better compete with Chinese export markets.

There may also be a way to utilize the programmatic definition of canceling HDPE to help California reclaimers better compete. This policy change would be separate from the grant program, and could be quite controversial. If, for example, the definition of canceling HDPE was changed from baling to shredding, then in order to obtain reimbursement for CRV, processors would be required to shred the material in California. This would eliminate the wholesale shipment of HDPE bales out of California. In order to export HDPE, brokers would be required to invest in shredding equipment and operations in California. Rather than relying on low-paid Chinese labor to sort and shred HDPE, brokers would be required to invest in the same labor and technology employed by California HDPE reclaimers. While this program change could help level the playing field with China, this option could result in unfair competition for domestic HDPE reclaimers operating outside California, as well as creating a number of logistical challenges.

As discussed in the PET section, there are also potential grant opportunities in R&D related to the growing use of barriers, colors, additives, and bio-plastics. The distinction between the seven plastic resins is getting murkier, as bottle manufacturers rely on additives such as calcium carbonate to change the properties of the resin. These changes at the manufacturing level can have major unintended impacts at the recycling level. The Association of Postconsumer Plastics Recyclers has a long history of working with manufacturers to incorporate design-for-recycling at the front-end, however, it is sometimes difficult for them to make necessary inroads. These resin issues are just starting to be of concern to recyclers and reclaimers, and they are likely to become increasingly problematic over time. Scientific research on the impacts of various additives and barriers on recycling, the need to redefine recycling codes as various chemicals are added to resins, and the impact of bio-resins on recycling, would be beneficial now, before these issues become severe.

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6. Bi-Metal and Plastics #3 to #7

These six beverage container material types are insignificant components of the AB 2020 program, and of recycled beverage container material markets. We address them briefly in this section of the report, however, not with the same level of detail provided for the other four CRV materials. In general, small quantities of these materials are generated, and even smaller quantities are recycled. Much of the recycling of bi-metal and plastics #3 to #7 occurs when they are mixed in with other more recyclable materials; bi-metal with tin cans, and plastics #3 to #7 with PET or HDPE. Often they are seen as contaminants in the process.

Table 6-1
Plastic Resin Types

Plastic Resin	Abbreviation
Polyethylene terephthalate	PET #1
High density polyethylene	HDPE #2
Polyvinyl chloride (vinyl)	PVC #3
Low density polyethylene	LDPE #4
Polypropylene	PP #5
Polystyrene	PS #6
Other plastic resins/blended resins	Other #7

A. Market Dynamics

Exhibit 6-1, on the next page, illustrates the low, and highly unstable, scrap prices for bi-metal and plastics #3 to #7. The scrap value for bi-metal has been stable at about zero. The lowest bi-metal scrap value occurred in 2003/2004, at negative $2.56 per ton, and the highest bi-metal scrap value occurred in 2005/2006, at $13.74 per ton. The average scrap value for PVC was around $10 to $15 per ton until 2005/2006, when it skyrocketed to almost $200 per ton. LDPE has shown similar variability, ranging between zero and $480 per ton. Similarly, PP has ranged from zero to $167 per ton, and PS has ranged from negative $187 to positive $132 per ton over the last eight years. Other #7 plastic has had a much smaller range, reaching a low of negative $37 per ton, and a high of $59 per ton. It is important to keep in mind, as we discuss below, that these scrap values are based on the extremely low volume of these materials that are recycled in California.

Nationally, only five percent of all plastic bottles made, and less than five percent of all plastic bottles recycled, use plastic resins #3 through #7. Given these low quantities, in their most recent annual report (2005), the American Chemistry Council (ACC) and Association of Postconsumer Plastic Recyclers (APR) stopped reporting on bottle quantities sold and recycled for these resins.

Exhibit 6-1
Bi-Metal and Plastics #3 to #7 Scrap Values, 1998 to 2006

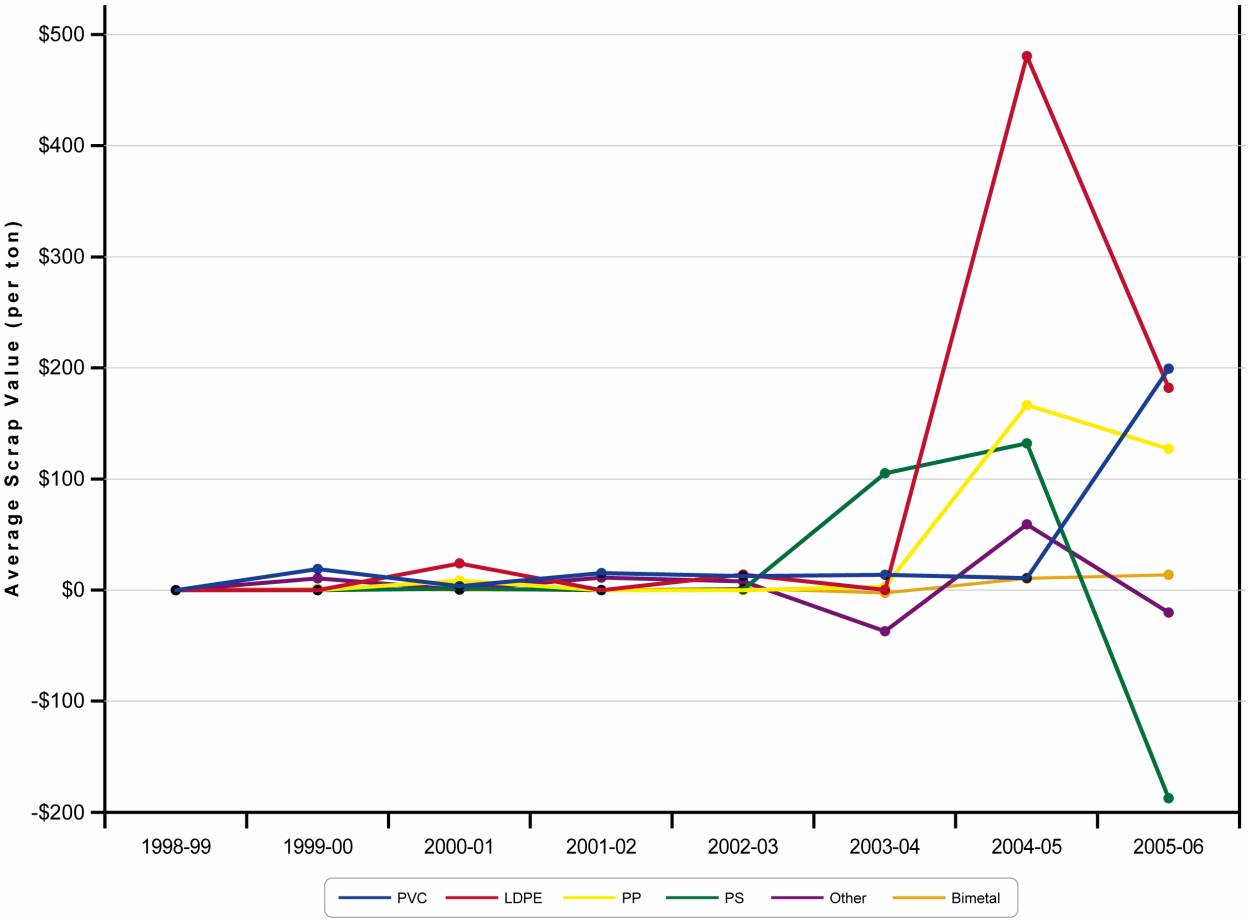


Table 6-2, on the next page, provides a comparison of the number of containers sold and recycled, and the percent of containers sold and recycled, for each of the ten material types in California. This table clearly illustrates the minimal role that bi-metal and plastics #3 to #7 play in the beverage recycling program. The most common of these materials, bi-metal and plastics Other #7 each make up only 0.2 percent of beverage container sales. On average, each person in California buys 1.3 bi-metal CRV containers per year, and 1.3 other #7 CRV containers per year. The least common beverage container is PVC, with just over 300,000 CRV containers sold per year, only 0.001 percent of beverage container sales. The least commonly recycled container is LDPE, with less than 6,000 CRV containers recycled statewide, only 0.0005 percent of beverage containers recycled.

Exhibits 6-2 through 6-7, on the pages that follow, provide the CRV sales and recycling for each of the materials. Note that the scales for recycling rates and number of containers differ for each exhibit.

Recycling rates for bi-metal, shown in **Exhibit 6-2** (right), are higher than for plastics #3 to #7, however they are still far below the four major CRV materials. In 2006, the bi-metal recycling rate was just below 8 percent. Sales of bi-metal CRV containers increased significantly when new containers were added to the program in 2000, however, they have dropped each year since 2003.

Table 6-2
Comparison of Sales and Recycling By Material Type, 2006

Material	Sales	Percent of Sales	Recycling	Percent of Recycling
Aluminum	10,018,815,900	45.7%	7,245,389,004	54.8%
Glass	3,608,513,760	16.5%	2,111,263,219	16.0%
PET	7,798,923,048	35.6%	3,652,022,572	27.6%
HDPE	368,095,875	1.7%	217,728,268	1.7%
Bi-Metal	41,529,914	0.2%	3,250,398	0.025%
PVC	314,221	0.001%	60,134	0.00045%
LDPE	6,462,289	0.03%	5,961	0.00005%
PP	3,945,154	0.02%	73,484	0.001%
PS	32,432,195	0.15%	250,652	0.002%
Other	41,525,903	0.19%	1,794,288	0.014%
Total	21,920,558,259	100.0%	13,231,837,980	100.0%
Total of Bi-Metal and Plastics #3 to #7	**126,209,676**	**0.6%**	**5,434,917**	**0.04%**

Exhibit 6-2
Bi-Metal Beverage Containers Sold and Recycled, 1988 to 2006

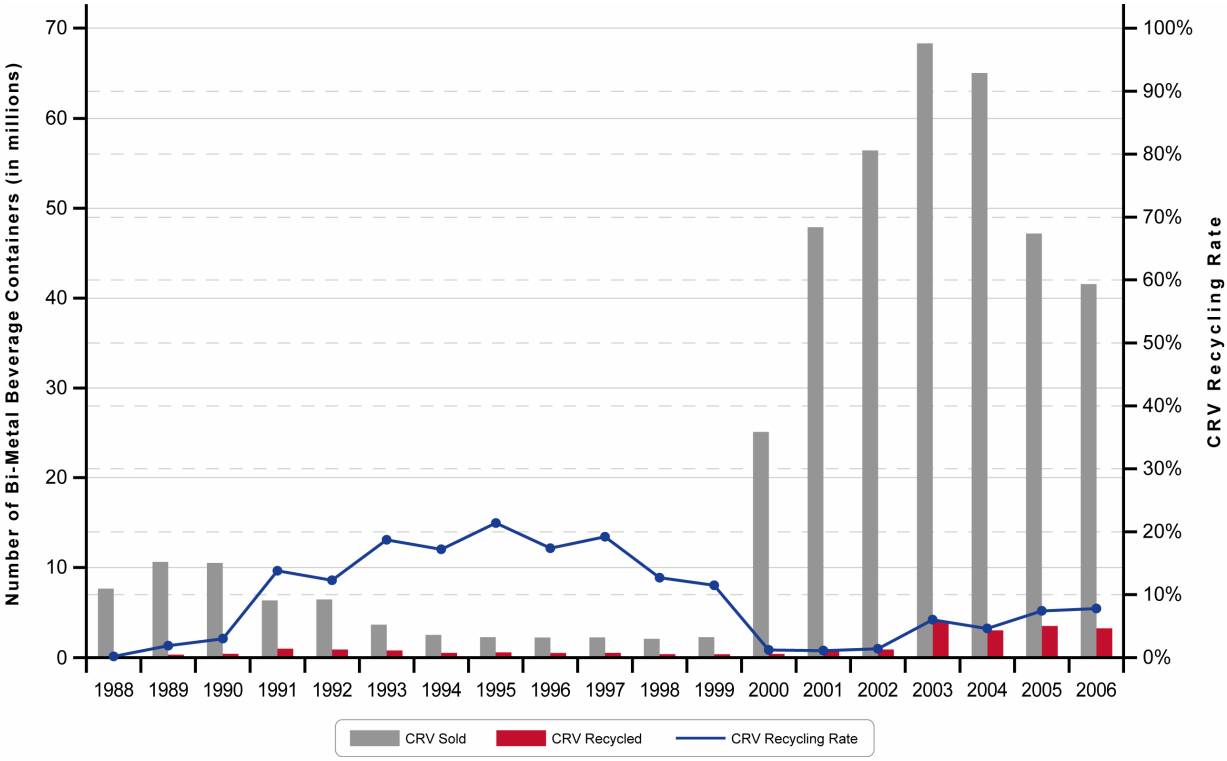


Exhibit 6-3
PVC #3 Beverage Containers Sold and Recycled, 2000 to 2006

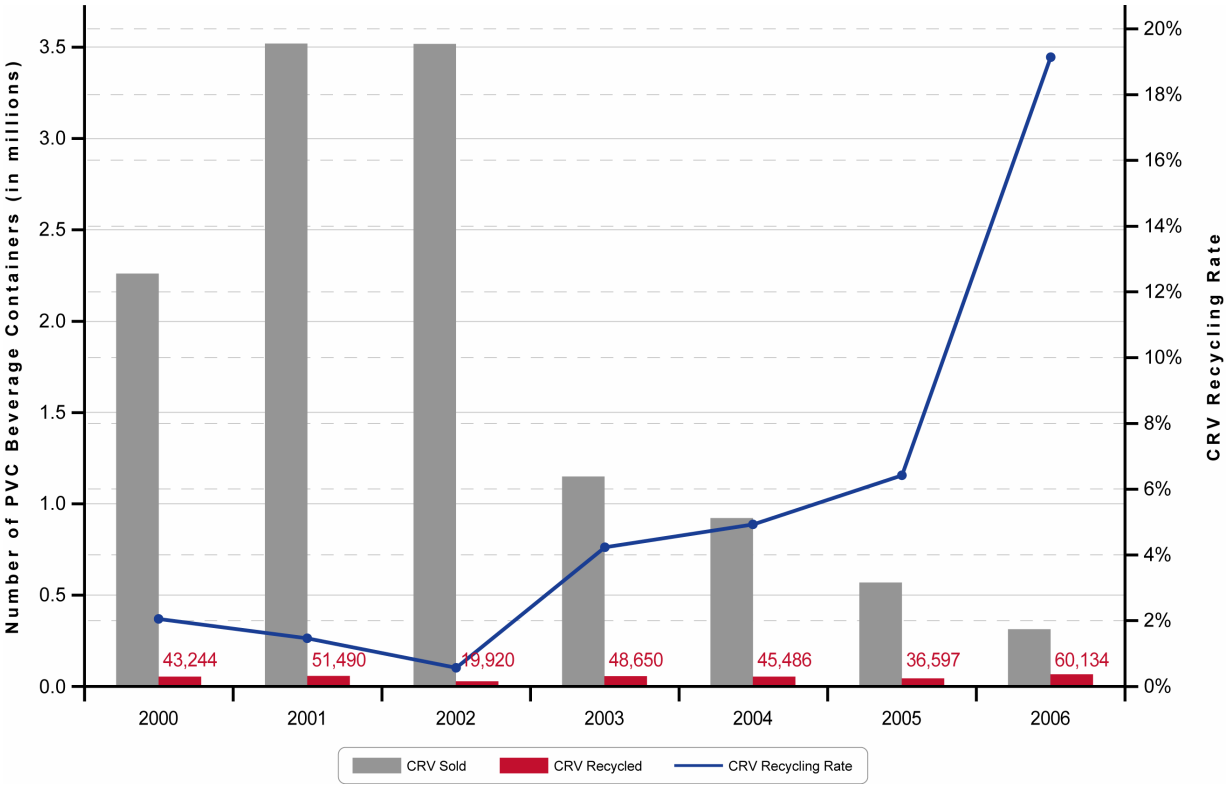


Exhibit 6-3, above, illustrates the decline in polyvinyl chloride (PVC) sales since 2002. There are several factors that could be contributing to this decline. PVC and PET are somewhat interchangeable as a beverage container, and PET is far easier to recycle. The material-specific processing fee for PVC, significantly higher than the PET processing fee, went into place in 2004, and may have caused some beverage manufacturers to switch away from PVC containers for their products. Furthermore, the use of PVC for beverage containers has been criticized because it is a contaminant in the PET recycling stream. While sales of PVC have dropped, the recycling rate has increased, although the total number of PVC containers recycled is miniscule. PVC can be recycled, and there are a number of companies that recycle this material, although the emphasis is not on PVC bottle recycling.

Exhibit 6-4, on the next page, illustrates recycling and sales for low density polyethylene (LDPE). There are very few beverages sold in LDPE, and like PVC, the number has declined since 2002. LDPE recycling is almost non-existent, representing on average two to three CRV LDPE containers recycled at each recycling center in the State in 2006.

Exhibit 6-5, on the next page, illustrates sales and recycling for polypropylene (PP), both of which, although still very low, have increased since 2002. KW Plastics of Alabama has bought baled loads of PP from California, although likely only a small share of this material is CRV. KW utilizes PP in paint pails, and would utilize more if it were available. In general, industry analysts report an increased demand for recycled PP.

Exhibit 6-4

LDPE #4 Beverage Containers Sold and Recycled, 2000 to 2006

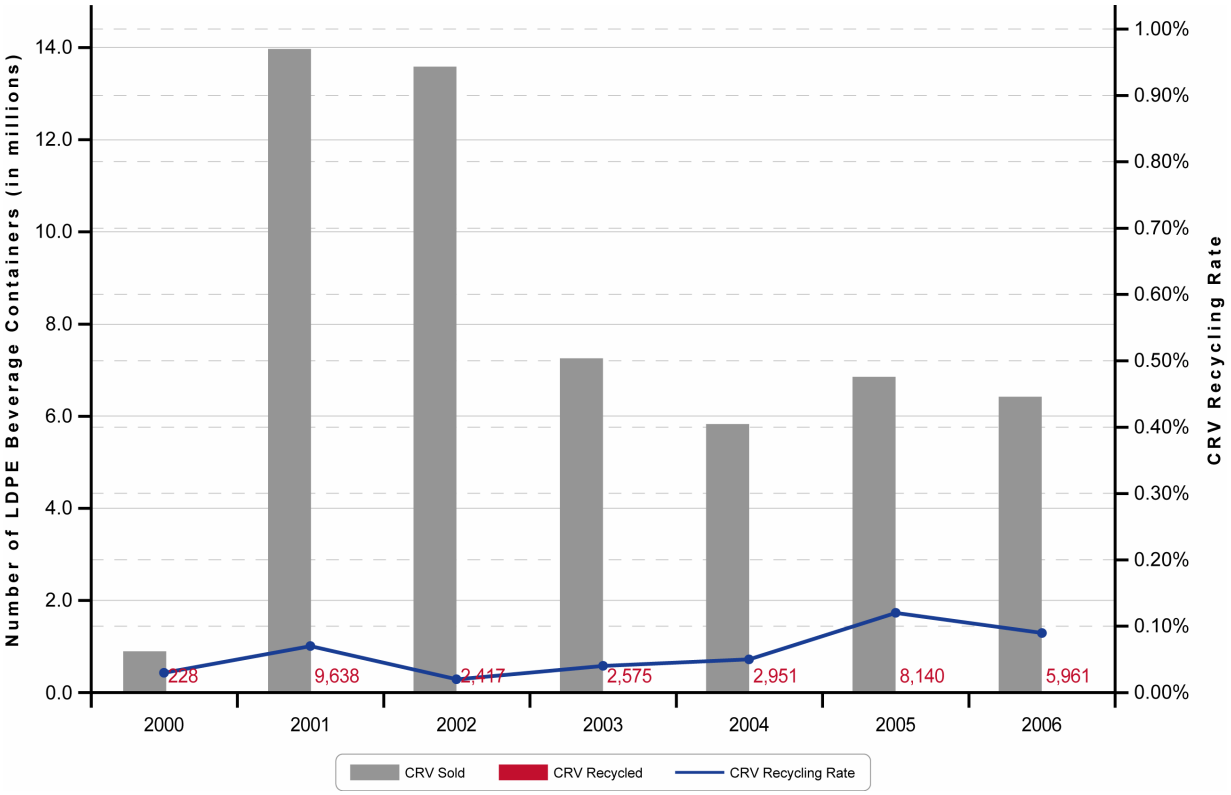


Exhibit 6-5

PP #5 Beverage Containers Sold and Recycled, 2000 to 2006

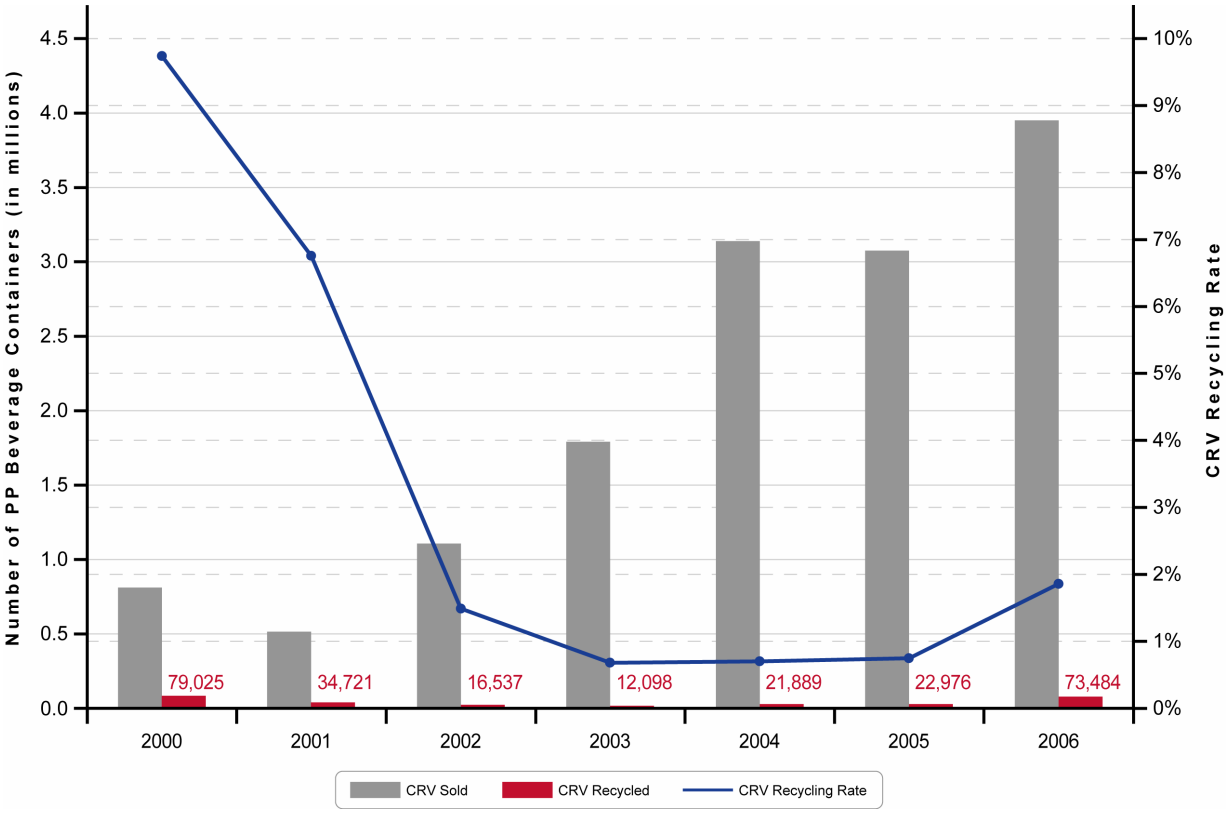


Exhibit 6-6
PS #6 Beverage Containers Sold and Recycled, 2000 to 2006

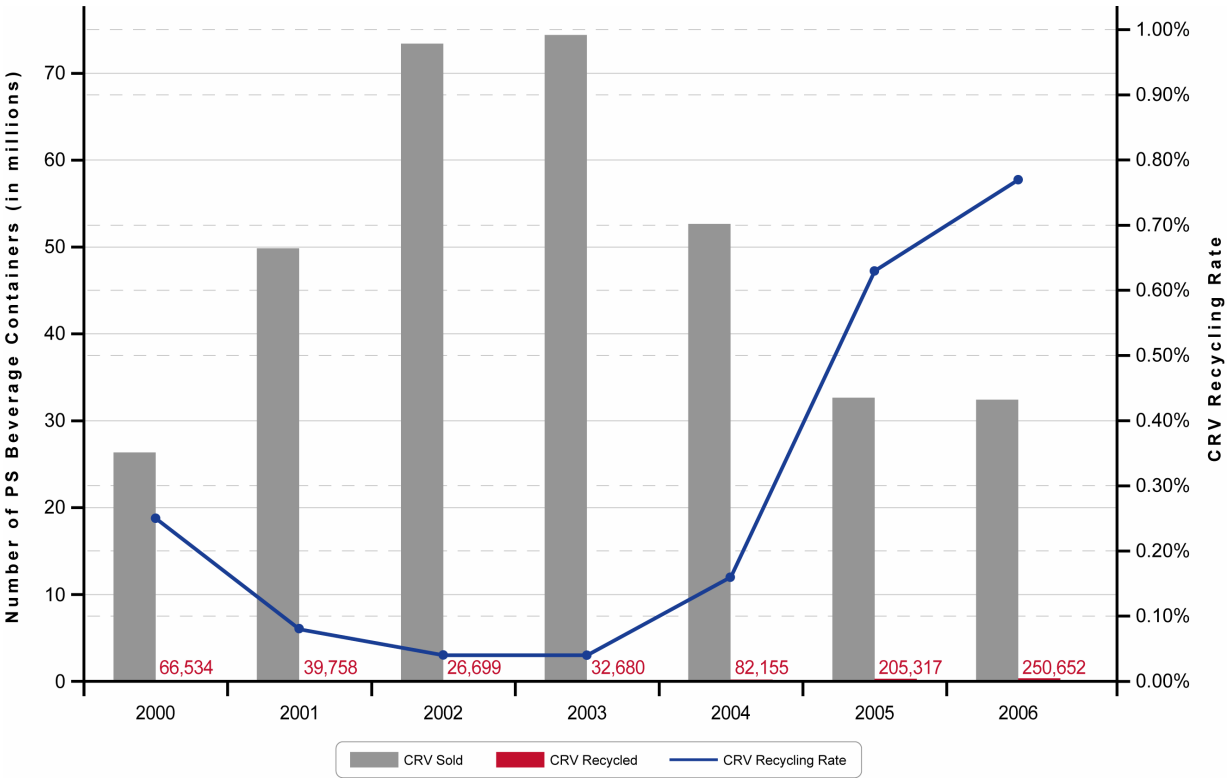


Exhibit 6-6, above, illustrates sales and recycling for polystyrene (PS). PS sales have declined by more than 50 percent since 2003. PS has limited applications as a beverage container, and is generally only used in the form of a foil-topped cup or juice. Recycling of PS has increased, although it is still extremely low.

Exhibit 6-7, on the next page, illustrates sales and recycling for other plastics (#7). This category typically includes beverage containers made out of more than one resin type blended together, or containers that include an additional barrier layer. Sales of beverage containers in Other #7 have increased since 2001, and are now at about the same level as bi-metal sales. Recycling of Other #7 has decreased since 2004, and is just over 4 percent.

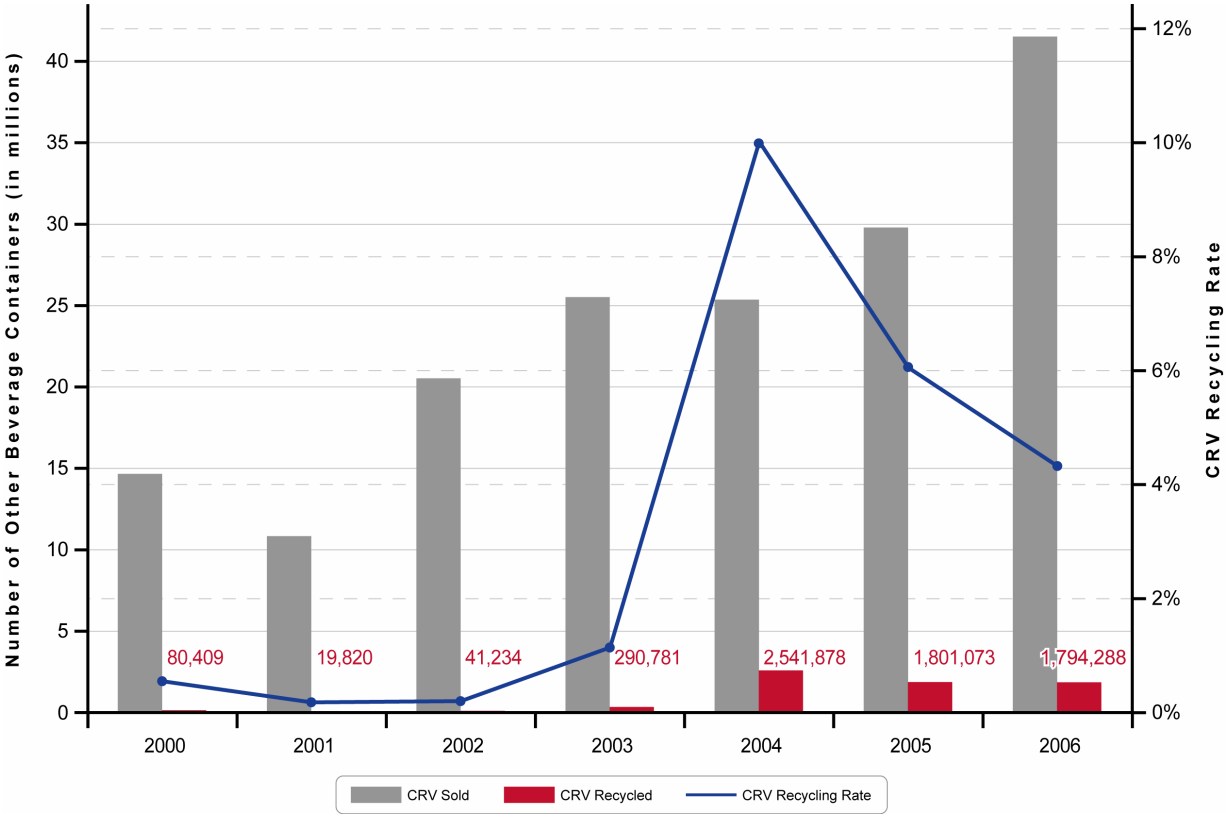
B. Market Players and Capacity

There are limited quantities, and limited markets, for these materials. Bi-metal is typically recycled with tin or steel. Because there is so little bi-metal recycled, the bi-metal bin is often a catch-all for a mix of containers (such as the PET/aluminum container) and garbage.

Much of the plastics #3 to #7 is recycled as a byproduct of HDPE and/or PET recycling. Mixed color bales of HDPE may contain up to 25 percent of plastics #3 to #7 and colored PET. While these materials are generally not counted as being recycled, there may actually be more plastics #3 to #7 recycled with HDPE than directly through buyback programs.

All three HDPE reclaimers in California are working to remove the minority plastic materials, and in some cases use them. Epic Plastics can

Exhibit 6-7
Other #7 Beverage Containers Sold and Recycled, 2000 to 2006



utilize all plastics except PVC and PET in their products. Although contamination rates may be higher, typically 5 percent to 10 percent of a mixed bale of HDPE consists of plastics #3 to #7 and PET. Thus, for every 1,100 pound bale, up to 110 pounds are plastics #3 to #7 or PET. There is no CRV paid on these materials, as they are considered contaminants in HDPE bales. Epic utilizes all such plastics #4 to #7 in their products.

Talco Plastics obtained a DOC grant in the 2006/2007 grant cycle to install optical sorting equipment to allow them to sort out PET and plastics #3 to #7 from HDPE bales. This grant is aimed at capturing the materials that are currently lost as contaminants in the bale, and reintroducing them into the marketplace, either in Talco's own reclamation processes (for PP), or selling them (for PET). Again, this material would be recycled, but it is not "counted" within the current system. Envision Plastics also optically sorts, and to the extent possible recycles, plastics #3 to #7 they receive in HDPE bales.

There is also incidental plastics #2 to #7 in PET bales. Guangyi Group buys as much as 7 million pounds per month of PET bales. Given these quantities, the amount of non-PET plastic may be significant, even at low contamination rates. Guangyi Group sorts these non-PET plastics at their facility in Southern California, flakes the material, and exports it to China with the PET. In China, the plastic is sold to factories located near Guangyi's Chinese fiber plant that utilize the material. Again, this plastic is not "counted" as recycled, as it is a contaminant in PET bales.

Plastics #7 is the only one of the minority plastics that is recycled in noticeable quantities,

although the volumes are still minimal. The majority of #7 plastic consists of Langer's juice bottles, which are made of predominantly PP #5. These bottles can be baled and recycled as PP, purchased by end-users such as KW Plastics.

C. New Alternatives

A variety of products can be made from plastics #3 to #7, either as single resin streams or mixed. PVC #3 generally must be separated from the other resins prior to end-use. A number of products can be made from mixed plastics #4 to #7, although many require some higher percentage of HDPE in the mix.

There are always new alternatives being identified for mixed plastic, for example Environmental Polymer Technologies in Wales has developed a molding process to fuse mixed plastic scrap to make products such as trays and bin lids to automotive parts, and perhaps eventually wood-core panels. Many of the alternatives for mixed plastics material are directed towards utilizing recycled film plastic, rather than utilizing recycled containers.

D. Market Issues and Barriers

The key market issue for bi-metal and plastics #3 to #7 is lack of material. This lack of material is not particularly a problem, as these materials also have little demand, and little value.

E. Grant Opportunities

The Department has provided grants for plastic optical sorting technologies to several companies. These technologies improve the quality of the primary plastic stream – PET or HDPE – while generating a secondary plastic stream – plastics #3 to #7. While grant funds could be utilized to develop end-products for these minority plastic materials, the Department should continue to maintain their focus on PET and HDPE. There is simply not enough volume of plastics #3 to #7 to warrant investment of State funds. Just because there are products that can be made from mixed or single resin plastics #3 to #7, this does not mean that the Department should spend significant grant resources on these materials. Similarly, as what little bi-metal is recycled in California is processed with tin cans, there is no need to invest State grant funds in bi-metal market development.

7. Summary

California's markets for recycled beverage container materials continue to evolve. The last few years have been good years for recyclers, with sustained record high scrap values. These high scrap values, combined with availability of funds from the Market Development and Expansion Grant Program, and increased focus on recycling, have led to significant changes in California's recycling markets. This final section of the report discusses (1) the growth in environmental awareness, (2) primary (bottle-to-bottle) versus secondary recycling, (3) competitive impacts of the grant program, and (4) market issues and implications for the grant program.

A. Growing Recognition of the Need for Producer Responsibility and Environmental Awareness

As concern over water quality, air quality, invasive species, and global warming mounts, there is a heightened awareness among the general public, and increasingly among main-stream industry, on the need to reduce environmental impacts of our day-to-day activities. This awareness is expanding from the relatively small niche of environmental activists and green businesses into mainstream business. There are signs that this responsibility is moving into the plastic industry, which many would argue has been slow to take responsibility for the environmental impacts of their products. For recycling, and recycled materials markets, these are all positive changes.

At a *Plastics News* Executive Forum, several industry representatives, particularly those in the plastic bag industry, noted the importance of environmental responsibility. Peter Grande of the California Film Extruders and Converters Association (CFECA) commented, "The plastics industry risks becoming irrelevant in the environmental debate, because too few companies are active in the public arena… You've got to take the approach that you are the leaders of your business, and as a result you're a pillar in your community. And so now you have a personal responsibility to be part of the solution." Laurie Hansen of the Progressive Bag Alliance said, "Now here in the 2000's, again recycling is back and back with a vengeance, and it has taken on a different phase, that phase is not another cycle this time. It's people like you and me who are sick and tired of seeing litter on our streets, of opening packages that have so many layers to them that we're disgusted with having to throw that away."[14]

Similar themes were expressed at the most recent Global Plastics Environmental Conference sponsored by the Society of Plastics Engineers (SPE). Participants at the conference had strong interest in bio-based and biodegradable plastics, and projects

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[14] Bregar, Bill. "Activist, officials urge plastics to go green" (Plastics News, March 19, 2007, 18).

designed to improve end-of-life recyclability. Several manufacturers, from Volvo, to auto parts manufacturers, to Wal-Mart, are looking at recyclability, sustainability, renewability, bio-based plastics, and more. Speaking at the meeting, plastics analyst Mike Schedler noted, "There will be a lot more pressure to recycle or die. I think the reality is that if we don't pay attention to these market developments and the public sentiment, we can be forced out of business. Governments are demanding higher diversion of materials from landfills and higher recycling rates. We have to put more focus on design for recycling principles. If we don't come up with solutions and ideas, we will disappear. This is our bottom line that is at stake."[15]

Eric Koester, another speaker at this same conference, noted the strong interest in venture capital investments for clean-technologies, stating, "there are plenty of investment dollars available", and "recycling projects and waste-to-energy projects are attracting the interests of governments and municipalities."[16]

An editorial column in the March 5, 2007 *Plastics News* notes that the plastics industry needs to capitalize on the availability of used plastic and use this for their own growth. They point out that the paper, aluminum, and steel industries have found a way to profitably incorporate recycled materials into their processes, and that far-sighted plastics companies should do the same.

While there are many critics of Wal-Mart, this company is now reportedly driving investments in environmentally sustainable packaging. Amy Zettlemoyer, responsible for sustainable packaging at Wal-Mart, spoke at the Plastics News Executive Form in San Diego in February 2007 about the company's packaging score card. The company buys from more than 60,000 suppliers in 70 countries, and is seeking to reduce packaging globally by 5 percent before 2013. Packages are being rated on (1) greenhouse gas emissions during production; (2) transportation; (3) ratio of product to package; (4) recycled content; (5) recovery value of the package material; (6) amount of renewable energy used during packaging production; (7) cube utilization (efficient use of space on pallets and shipping containers); (8) innovation; and (9) injury rates.

Wal-Mart may drop suppliers if they don't make packaging innovations, and promote suppliers who use green packaging. Wal-Mart will be gathering information for next year or so, and will use third party standards such as American Society for Testing and Materials (ASTM) guidelines to the extent possible. Wal-Mart has been willing to take a half-cent cost increase on green packaging from a few suppliers, even though they are still cost conscious.

This trend towards greening of industry is encouraging, however, some within the industry note that the immediate bottom-line is still the most important factor for most businesses and consumers. There is always concern by some that the industry's environmental awareness is just a passing fad, or just to provide good public relations.

The recent hype of this new green trend does not always make it down to the street-level. A recent article in *Resource Recycling* noted that even though mainstream industry in the San Francisco Bay Area felt that recycling businesses were important, cities in the East Bay were generally not interested in siting recycling based businesses. In addition, energy costs, transportation, and high real estate costs made it difficult for new companies, particularly those in low-margin activities like recycling. As a result, recycling-based businesses in the San Francisco Bay Area are moving either out-of-state or to the Central Valley. One of the greatest barriers faced by recycling-based businesses is obtaining the necessary

[15] Mike Verespej, "U.S. firms' design agendas getting greener" (Plastics News, March 26, 2007, p.9)

[16] Mike Verespej, "Investment dollars follow green thinking" (Plastics News, March 26, 2007, p.13)

operating permits from local governments and/or air and water quality agencies.

There is need for a more holistic or systemic approach to recycling and environmental awareness in general. The Department of Conservation is beginning to incorporate such an approach into their program, defining the concepts of product stewardship and recycling sustainability, as follows:

> Product stewardship is a product-centered approach to environmental protection. It calls on those in the product lifecycle, manufacturers, retailers, users, and disposers to share responsibility for reducing the environmental impacts of products. An example may be a retailer taking responsibility to ensure containers are collected and processed to become high quality feedstock for the manufacture of a new container.
>
> Recycling sustainability is an attempt to provide the best outcomes for the human and natural environments both now and into the indefinite future. Common elements included are: minimal consumption of natural resources; reuse or recycling all waste; no polluting or emitting of waste beyond what ecosystems can breakdown and harmlessly recycle; and reliance on clean, renewable energy.

B. Primary (Bottle-to-Bottle) versus Secondary Recycling

There is ongoing controversy over primary, or bottle-to-bottle, versus secondary recycling for beverage containers. The 2005 Market Analysis identified four factors that are relevant in choosing one end-use alternative over another:

1. The price that a given end-use will bring for the recycled material
2. The cost to process the recycled material to a point of end-use readiness
3. The relative environmental impacts of the process, and of the raw material that the recycled material is replacing
4. The likely fate of the end-use product.

In some cases, and for some materials, the "best" end-use, based on the above four factors, is back into another bottle. In other cases, it may be more efficient to recycle a container into a totally different product (secondary recycling).

That said, there are several factors that make bottle-to-bottle recycling an appealing alternative for beverage containers. First, the scrap price that is paid for bottle-to-bottle recycling is generally higher than for other end-uses. In part, this is because the recycled material is of higher quality, and likely required more extensive processing. The point when bottle-to-bottle recycling becomes uneconomical is when the processor must spend more to process the material to bottle-grade quality than they can sell the material for. Improvements in processing technology can help reduce the cost of processing bottle-grade material, making bottle-to-bottle recycling a better alternative.

In general terms, when recycled materials replace raw materials with greater negative environmental impacts, the use of recycled materials is preferred. This is the case whether the materials are going into a bottle-to-bottle or secondary application. For aluminum and glass, there are additional energy savings benefits from using recycled versus virgin raw materials when producing containers. Certainly, if one is looking at the issue from the point of view of reducing the environmental impact of producing a container, then using recycled material container is a preferred alternative to using virgin material.

The fate of the product is an important consideration for beverage containers. Beverage containers have an inherently short life cycle. The aluminum industry points out that it takes about 60 days for a recycled aluminum can to make it back to a consumer as a new beverage container. If the beverage container is not recycled, then its useful lifespan, before it ends up permanently in a landfill, is very short. When recycling rates for a

Table 7-1
Recycled Content for the Four Major Beverage Container Materials

Material	CRV Recycling Rate (2006)	Typical Post-Consumer Recycled Content	Potential Post-Consumer Recycled Content	Comments
Aluminum	72%	42%	90%	Recycled content in aluminum cans is higher than any other containers, and it is primarily limited by the supply of recycled aluminum cans, although technical issues may prevent manufacturers from using 100% recycled UBC
Glass	58%	37%	70%	Glass manufacturers say they could use up to 70% recycled content, if enough high-quality material was available
PET	47%	10%	50%	Coca Cola and Pepsi agreed several years ago to use 10% recycled PET in their bottles, although Coca Cola recently said they could use 50%. Using PET in bottle-to-bottle applications is a higher-end alternative, compared to sheet-based products
HDPE	59%	25% (for non-food containers)	30% (for food and non-food containers)	The current 25% level in non-food bottles is fairly standard in the industry. Because the supply of HDPE is limited, there has been less incentive to pursue food-grade applications, although that is changing. Like PET, food grade HDPE is a higher-end application.

particular container type are high, and containers are recycled many times back into new, useful containers, bottle-to-bottle recycling becomes more sustainable, and helps counteract the short life-span of beverage containers. When recycling rates for a particular container type are low, bottle-to-bottle recycling only slightly delays the bottle's ultimate landfill disposal. In these cases, recycling the container back into a product with a longer lifespan is more beneficial environmentally.

Each of the four major beverage container types, aluminum, glass, PET, and HPDE, have different characteristics related to bottle-to-bottle recycling. What makes the most sense environmentally and economically for aluminum does not necessarily make the most sense for the other containers. For all four beverage containers, there is room for improvement, in terms of increasing recycled content levels. For PET and HDPE, in particular, shifting towards California production of bottle-grade recycled resin would provide a higher-value alternative that could help California reclaimers compete with the Chinese export market. **Table 7-1**, above, examines current and potential bottle-to-bottle recycled content among the containers.

C. Grants and Competitiveness

The Market Development and Expansion Grant Program provides the Department with an opportunity to positively stimulate recycled beverage container material markets. In its first four years, the grant program has helped to significantly change the recycling landscape in

California. The program has allowed companies operating in California to speed-up the investment timeline, or to make recycling investments that many would not otherwise have been able to do.

The Grant Program also places a responsibility on the Department to consider the market impacts of the grants that are awarded, and the grants that are not awarded. In evaluating and awarding grants, the Department must not only consider sound investment of government resources, but the broader market impacts of their actions. Overall, the Grant Program has had a positive impact on glass, PET, and HDPE recycling markets in California. And, while the Grant Program provides a significant injection of outside funds to an industry, a specific business still needs a major investment of their own, as well as a solid operating plan, in order to succeed.

At the same time, some recycling-related businesses have not received grants, while others have. For those businesses operating in the same material markets, there is clearly a competitive advantage for those who do receive Grant Program funding.

Many grant recipients, particularly for PET reclaiming, have faced challenges and delays, and are not yet operational. There may have been other companies that could have received similar grants to support new California PET reclaiming capacity, and perhaps been operational by now. It would be next to impossible for Department grant evaluators to determine up front, with 100 percent accuracy, which projects will succeed and which will fail. However, when projects fail or are delayed, those who did not receive grants are left wondering why and are frustrated that their companies would be in a better market position if they had received grant funding instead.

Even with the potential competitive imbalance from the grant program, many California recycling businesses, particularly in the plastics industry, expressed that they were more concerned about competing with China, and the competitive disadvantages faced by California companies in relation to China, than in competing among themselves. These operators felt that at least in competing within California, with or without grants, all companies face the same labor, worker's compensation, energy, water, transportation, and bale playing field economics. In facing China, however, they are competing against government subsidies and a far cheaper labor structure.

There were still several concerns raised about the Grant Program and impacts on competition. The Grant Program has had the most significant impacts on competition in PET reclaiming. While strong PET markets would likely have stimulated PET reclaiming in California, even without grant funding, the availability of grants has been a major factor in changing the PET reclaiming landscape in the State. There is significant planned PET reclaiming capacity, and likely future overcapacity in California, much of it supported by grants. The Department must carefully evaluate new grant projects, not just on their own merits, but on how they fit within the overall market, and how they impact competitors.

D. Summary of Market Issues and Grant Program Implications

The recycled beverage container material market landscape in California has changed dramatically over the last three years. While we did not expect that the market would be stagnant, we were surprised at the level of change that has occurred for all four of the major beverage container materials. In some cases, these changes reflect entirely new market dynamics, while in others, they reflect the continuation or extenuation of trends that were in place a few years ago. **Exhibit 7-1**, starting on the next page, summarizes key market issues, potential solutions, and implications for the Grant Program.

Exhibit 7-1
California Recycled Beverage Container Material Market Issues and Implications Page 1 of 5

Issue	Potential Solutions	Implications for Grant Program
*Lower than historical recycling rates for **aluminum**.* One billion fewer aluminum containers were recycled in 2006 as compared to 1995. Thus far, the Grant Program has not focused on collection of recyclables, which is the key market barrier for aluminum.	Promote aluminum can collection systems, perhaps building on relevant aspects of Brazil's collection cooperatives. Education and market incentives to stimulate aluminum recycling among consumers. Technical solutions to sort more aluminum from curbside single stream.	Redefine Grant Program criteria to allow use of funds to promote or stimulate collection of aluminum materials. Support R&D projects to improve aluminum recycling, including "mining" materials from landfills, as well as front-end recycling. Support technical solutions for sorting aluminum from curbside.
*Unusual market dynamics for **aluminum** making it increasingly challenging to find markets for West Coast aluminum.* High aluminum scrap prices are leading to an oversupply of recycled aluminum, exacerbated by seasonality of demand by secondary smelters.	Need to identify additional markets for recycled aluminum. Encourage secondary smelters to increase capacity for aluminum UBCs.	Support R&D for new aluminum markets in California.
*Lack of markets for **glass** cullet in Southern California.* Two glass container manufacturers in the South State have closed in the last two years. Much of the glass generated in Southern California is shipped out-of-state.	Identify new markets for glass cullet, particularly in cement applications. Increase use of recycled glass in Northern California container and fiberglass manufacturing.	Fund projects that identify and support new markets, focusing on applications for glass in cement and ceramics. Fund projects that support new glass processing capabilities to meet new market specifications. Support projects that increase use of cullet in California glass container and fiberglass manufacturing locations.
*Increased volume of three-mix **glass** from single stream curbside programs.* Almost one-half of recycled glass in California comes from curbside programs. The majority of this glass is low quality three-color mix, averaging 8 to 15 percent contamination, with some much higher (20 to 30 percent).	Further improve glass cleaning and sorting capabilities at MRFs and beneficiating processors. Utilize single stream best practices. Better education and enforcement of single stream programs to reduce contamination.	Continued funding for technologies to clean and sort mixed glass.

Exhibit 7-1

California Recycled Beverage Container Material Market Issues and Implications

Issue	Potential Solutions	Implications for Grant Program
*Approximately 95,000 tons per year of **glass** fines are shipped to landfills for no-value uses.* This material is generally too small to be sorted and cleaned for container and fiberglass industries, and there are few uses for the material.	Identify new markets for glass fines. Utilize improved sorting technologies that can accommodate smaller material, thus reducing the volume of fines that cannot be utilized by glass container and fiberglass manufacturers.	Fund projects that identify new markets for glass fines. Support projects to utilize sorting technologies for glass less than ¼ inch in size.
*Structure of existing **glass** processing industry focuses on high-volume end-markets.* The large beneficiating processors are (understandably) operating on a high-volume scale that is not necessarily compatible with high-value, but low-volume, end-use alternatives.	Implement low-volume glass processing for high-value end-use markets such as tile, glassware, blasting medium.	Support projects that develop low-volume glass processing for high-value end-use markets.
*Increase in **PET** clean flake capacity.* Over the next few years, there is likely to be over-capacity of PET reclaiming capability in California, particularly for saturation of the clean flake to sheet market.	Support final end-uses for recycled flake.	Do not provide grants to further increase PET clean flake capacity until the disposition of the recent capacity expansion grants is known. Support projects for end-uses of recycled PET, including packaging, strapping, bottles, and new alternatives.
*China's demand for California **PET** and **HDPE**.* Long-term demand for California recycled PET and HDPE from China is uncertain. In the last 18 months, Chinese demand for recycled HDPE has been strong, creating additional competitive pressures on California and domestic reclaimers. China continues to import most of California's recycled PET.	Support domestic uses of recycled PET and HDPE in order to increase market stability. Provide incentives for use of California recycled PET and HDPE to reduce the "un-level" playing field. Reduce dependence on export to lessen the impact of potential recycled plastic price decreases due to reduced China export demand and/or falling virgin plastic prices (when they occur sometime in the future).	Support domestic uses of recycled PET and HDPE, not projects that will lead to increased exports. Support projects to improve the quality of California PET and HDPE, which will make the material more attractive to domestic markets. Support high-value end-use markets for recycled PET.

Exhibit 7-1
California Recycled Beverage Container Material Market Issues and Implications

Issue	Potential Solutions	Implications for Grant Program
*Challenge of **plastics** competing with China.* It is extremely difficult for California companies to compete with China for recycled **PET** and **HDPE.** As California companies produce clean recycled PET flake and sheet, China is also exporting these materials to California, lowering prices.	Leverage advantages of California material – improved quality, ability for immediate delivery. Provide economic incentives for California operations (some included in AB 3056). Partner with Chinese companies, rather than compete directly (this model is taking place in the paper and other industries). Consider revising the definition of canceling HDPE and help keep material in California.	Promote improved quality of California PET and HDPE material. Support projects for end-uses of recycled PET. Consider projects with established Chinese partnerships (this concept is controversial, and would require further analysis).
*Demand for recycled **PET** bales is greater than supply.* There is not enough recycled PET to meet combined demand from in-State current (and future) reclaiming capacity, exports, and out-of-state demand.	Increase volume of PET recycling. Increase incentives to recycle PET such as increasing CRV, and recycling incentives. (Increased CRV occured in 2007, AB 3056 includes other recycling incentives.) Increase sorting capabilities for curbside programs to increase the amount of HDPE obtained. Improve California reclaimer's competitiveness in relation to China and other domestic users. (Plastic Market Development provisions in AB 3056 may help.)	Support improved efficiency of PET reclaiming. Support increased use of automated sorting at MRFs and curbside facilities. Redefine grant program criteria to allow use of funds to promote or stimulate collection of materials.
*Dependence on the **PET** sheet market.* The sheet market is the predominant market for clean PET flake in California. The sheet industry in general is relatively flexible; has easy entry (and exit); few environmental concerns; and seeks the lowest price resins, including off-specification resin as opposed to recycled flake. China is also exporting clean flake and sheet to compete with California material. California's future reclaiming capacity, when built out, will be extremely dependent on the sheet market as an end-use, a situation that could lead to business failure if flake prices and/or demand drop.	Increase enforcement of the RPPC law. Provide incentives for use of California recycled PET (RPET) to support viable sheet end-uses using RPET.	Support diversification and end-uses for recycled flake in addition to sheet. Support thermoforming end-use applications for recycled PET sheet.

Exhibit 7-1

California Recycled Beverage Container Material Market Issues and Implications

Issue	Potential Solutions	Implications for Grant Program
*Lack of enforcement of Rigid **Plastic** Packaging Containers (RPPC) law.* The RPPC law is extremely difficult for the CIWMB to enforce. As a result, many packaging producers (particularly in the sheet industry) do not utilize recycled PET, unless it happens to be the lowest cost material available.	Increase enforcement of California postconsumer resin (PCR) requirement in the RPPC law.	Support increased enforcement of the RPPC law to increase incentives to utilize clean flake produced in California, increasing the end-use markets for clean California flake.
*Need for food-grade recycled **PET** (i.e. with FDA Non-Objection Letter).* There is interest in using recycled PET in food contact take-out and other containers, however, there are no producers of food-grade PET flake in California.	Support PET reclaiming capacity for food-grade recycled PET.	Support PET reclaiming capacity for food-grade recycled PET.
*Lack of markets for green, amber, and blue **PET**.* These three colors now make up about 30 percent of the PET recycling stream, and this amount is likely to grow.	Identify new markets for green, amber, and blue PET.	Support R&D or implementation of new alternatives for green, amber, and blue PET.
*Increased use of **plastics** additives, mutilayers, barriers, and bio-resins.* The addition of barriers, layers, and additives to plastics, particularly **HDPE and PET,** negatively impacts recycling, processing, and reclaiming. The distinction between, and definition of, the seven coded plastic resins is no longer clear. Furthermore, the growing use of bio-resins such as PLA are also negatively impacting recycling, processing, and reclaiming.	Conduct scientific research on the impact of various additives, multilayers, barriers, and bio-resins on recycling, processing, and reclaiming. Conduct scientific research on resin coding and definitions, in light of current applications of plastics in the marketplace.	Fund R&D on the impact of additives, multi-layers, barriers, and bio-resins. Fund R&D on resin coding definitions. Collaborate with the Association of Postconsumer Plastic Recyclers (APR) on design-for-recycling and related research on the implications of additives and barriers.
*Low recycled content in **PET** bottles.* PET beverage container bottles in the U.S. currently are only 10 percent recycled content.	Conduct pilot projects to test higher recycled content bottles in the marketplace. Encourage Coca-Cola and Pepsi to increase recycled content in their PET containers.	Fund pilot projects to produce higher recycled content PET beverage container bottles.

Exhibit 7-1
California Recycled Beverage Container Material Market Issues and Implications

Issue	Potential Solutions	Implications for Grant Program
*Lack of supply of recycled **HDPE**.* Although the number of CRV HDPE containers recycled increased by 9 percent in 2006, there is still an inadequate supply of recycled HDPE to meet reclaimer and end-use demand.	Increase incentives to recycle HDPE such as increasing CRV, and recycling incentives. (Increased CRV occured in 2007, AB 3056 includes other recycling incentives.) Increase sorting capabilities for curbside programs to increase the amount of HDPE obtained. Improve California reclaimer's competitiveness in relation to China and other domestic users. (Provisions in AB 3056 may help). Add milk or other HDPE containers to the CRV program to increase the quantity of HDPE recycled.	Support improved efficiency of HDPE reclaiming. Increase use of automated sorting at MRFs and curbside facilities. Redefine Grant Program criteria to allow use of funds to promote or stimulate collection of materials.
*Low quality of colored **HDPE** bales.* The inclusion of plastics #3 to #7 in the CRV program has resulted in significant contamination of colored HDPE bales with plastics #3 to #7 and PET #1. Given a sellers market, reclaimers cannot afford to turn away these bales, even if they don't meet quality standards.	Increase sorting capabilities for curbside programs to increase the amount of HDPE obtained and remove plastics #3 to #7 and PET #1. Identify markets for plastics #3 to #7.	Support increased sorting capabilities for curbside programs to increase the amount of HDPE obtained and remove plastics #3 to #7 and PET #1. Support projects that utilize plastics #3 to #7, although do not spend significant resources on these minor materials unless they also benefit PET and/or HDPE markets.
Siting manufacturing in California. Permitting manufacturing facilities in California is extremely difficult and costly, and creates a barrier to developing facilities locating in California.	Provide a directory of local contacts to assist grantees and others with siting and permitting recycling-related facilities. This would include water, air, planning, and other specialists, perhaps contracted with DOR on an on-call basis.	Provide an infrastructure support system for grantees that would increase the beneficial impacts of grants, perhaps significantly reducing the time to implement projects. Given the nature of local government permitting, this alternative would be most effective if the support was local.

Appendix A

Literature References and Interviews

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Section 1: Introduction

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Section 7: Summary and Recommendations

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